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ANNOUNCEMENTS.

FEILDEN'S MAGAZINE is published at the *beginning* of every month.

In consequence of the large number of pages to be prepared and passed for press, the careful nature of the printing required for high-class production, the advance arrangements made for extensive circulation, and in order to facilitate departmental business, observance of the following rules is necessary:—

Literary Matter to reach the offices not later than the 15th of the month (as much earlier as possible) previous to date of publication. Communications to be addressed "Editorial Department."

Advertisements intended for insertion in next issue must be received not later than the 15th of the month (as much earlier as possible), to insure correct classification. All communications respecting same to be marked "Business Department." Advertising Rates, on application, regulated according to positions available.

Subscriptions and letters with reference to copies to be marked "Subscription Department."

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For Buyers' Guide Index to Advertisers, and Directory of leading British Manufacturers, see page ii. of second cover, and pages iii. to xiii. (in first part of Magazine).

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The "Opening-Up" of China.

China is acknowledged to be the richest country in the world in natural resources. Its vast land area is fertile and highly cultivated. Valuable minerals are found in abundance in the country, where they have lain unworked for ages; yet with all these advantages, and with a teeming population estimated to amount to some four hundred millions, the outside trade of China is less than that of Japan with a population of only forty millions. The following are the figures for the year 1898:—

Chinese imports ...	£26,616,025
Chinese exports ...	£25,559,798
Total foreign trade of China	£52,175,823
Japanese imports ...	£34,611,311
Japanese exports ...	£17,750,599
Total foreign trade of Japan	£52,361,910

This is a curious contrast, especially when we consider the comparative resources of the two countries. The reason for it is to be found in the Chinese objection to external intercourse, a thing which the Japanese eagerly welcome. Japan did not wait to have Western civilisation forced upon her. She pursued it, captured it and made it her own. China is waiting, sullenly opposing her giant inertia against the reforms which the detested missionaries of an alien cult are seeking to make in the more exposed portions of the vast carcase now set before the enterprise of the world.

During the next ten years, all the same, we may expect to see a remarkable change in Chinese trading conditions. The resistance to what we are accustomed to consider progress comes in China almost entirely from the official classes, the *literati*, who form so important a part of the bulk of the population and the priesthood.

The average Chinaman, on the other hand, is a born trader, gentle and inoffensive in his manners, and characterised by an honesty and straightforwardness in his commercial dealings, striking to even an Englishman. It is this part of the Chinese population that we must come in touch with, for in the great trading class undoubtedly lies the destinies of the country. Officialdom is corrupt from top to bottom; the priesthood ignorant and debased. Both must go, and will go in course of time, and China placed under a cleaner and more healthful rule. In those days to come, we may look forward to the realisation of a dream of development unknown heretofore in the world's history. The patient, inoffensive labouring millions of China, her vast areas of fertile land tilled like a kitchen garden, her stores of mineral wealth—iron, coal, gold, silver, copper, mercury, lead—manipulated by an equally enormous field of docile and intelligent labour—these constitute potentialities of wealth never yet in the possession of any nation under such circumstances, whose long-delayed utilisation must ultimately exert a far-reaching influence upon the world at large.

The region of China associated with British enterprise is that known as the Yangtze Valley, recognised as the most fertile portion of the country, and of the greatest trade promise. The British position here does not appear to be very well defined. Everyone who has gone over China has expressed a marked objection to the phrase "sphere of influence" in relation to British policy, and it is just this expression that is supposed to place the Yangtze Valley under British moral jurisdiction. However, definitions are best left to diplomatics, and as everyone appears agreed as to the policy of the "open door," which is all we ourselves desire to obtain, the real question is, How to so organise our efforts for the promotion of British trade in interior China, so as not to be left ignominiously in the rear. Lord Charles Beresford, whose exertions in the promotion of the commercial prestige of his country are beyond all praise, says that the industrial invasion in China is likely to be divided in priority as follows:

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railways and electricity; mining and allied works; manufactures. As regards railways—in whose adoption, contrary to Mr. Hiram Maxim, we do not discern the prospective destruction of the Chinese nation—we are undoubtedly more than holding our own, though the absence with us of those advertising tactics which some rivals seem to consider profitable may give the ignorant a different impression. In electricity our position is by no means so assured; and in this, so important a part of the equipment of modern civilisation, we have the gravest misgivings unless some special exertion be made to place British industry in this respect upon a proper footing. In electrical plant for China we have to compete not only with the United States but with the Japanese, and unless, as Lord Charles Beresford has stated, British engineers are more energetic the Chinese orders will go to Japan and America.

But the great essential is a number of capable, enthusiastic British trade envoys, who should represent the industries of this country and carry out the work which Lord Charles Beresford has so ably begun. Many of these are already at work, without any flourishing of trumpets; but we want many more. We want more ways of bringing the advantages of mechanical appliances home to the Chinese. This can be done most effectually by practical illustration, and for that purpose the actual machines, plant or other objects must be in view.

What are the best means of effecting this object? Lord Charles Beresford suggests exhibitions. Very well. But who is to promote them? Some will answer at once, the British Government. Others will suggest the British Chambers of Commerce. Others again, British manufacturers themselves. No doubt all these solutions are worthy of consideration, but, speaking for ourselves, if British exhibitions of plant and machinery are ever set on foot in China—of which we have the gravest doubt—they will never be originated by either the British Government or the British Chambers of Commerce; nor, we think, by associated action of British manufacturers. The British manufacturer does not now require, nor does he desire, extraneous assistance. All he claims is a clear field of competition, without artificial impedimenta in the shape of dues, likin, or otherwise. Averse from common action, he is beyond all things determined to preserve his individuality, and, with his sturdy resolute nature, to work out his own purpose unhelped, but unhindered, by anybody.

The British manufacturer, in fine, is determined to have his full share of Chinese trade, no matter what obstacles stand in his way; and, having started with this determination, it is as certain as anything in this world can be that he will get it.

Some Last Words on Consular Reports.

THE detailed criticisms we have made from time to time on the character of the Consular Reports supplied to the Foreign Office, so far as they affect the trade and manufactures of the country, have aroused a large volume of correspondence and general public attention which we can deal with on only a very limited scale.

One criticism, contained in an editorial published by our daily contemporary the *Financial Times*, we must altogether take exception to. Our contemporary tries to make out that we have asserted the statistics—which, as the *Financial Times* expresses it, "usually and very properly form part of our Consuls' reports"—are "worthless." We have never said anything of the sort. What we have maintained is, they are for the most part quite valueless to our manufacturers, and anyone who possesses a knowledge of the producing industries of this country will know our statement to be a fact. As to what the diplomatic advantage of these statistics may be we do not profess to express an opinion, excepting that even from this point of view the value of a considerable proportion of them is very dubious, considering the circumstances under which they are prepared.

These annual Reports are mostly the work of a host of unpaid vice-consuls,

whose only reward for their labours is the gratification of beholding the results of their exertions in print. The Reports are drawn up on rigid lines formulated by the Foreign Office, and, under these circumstances, as our readers will have seen, form, for the most part, a curious *mélange* of random statistics and *maladroit* attempts to impart commercial information.

With the starting of the new Commercial Intelligence Department, however, we may anticipate some alteration in the character and contents of these Reports, which probably will not pretend to possess any specific value in the promotion of our export trade, fulfilling, perhaps, much the same purpose as the Bureau of Statistics in the United States.

Meanwhile, we find it only fair to state that in preceding articles we have not quite done justice to the work of some of our Consuls abroad. We have received a number of letters, in which the authors point out that they have, on many occasions, sent Special Reports on commercial subjects to the Foreign Office, and these, though not appearing in the Consular Blue Books, have been published in the Board of Trade Journal, and thus disseminated through other channels of general publicity. We have also to correct a misapprehension that may have arisen from our article in respect to the Consular Report received in August last from Rio Grande do Sul. It has been pointed out to us that the details published respecting the "Principal Causes of Death," and the "Burials in the Protestant Cemetery of Rio Grande do Sul," were secured on behalf of some British Life Insurance Companies. Being without this information at the time, these tabulated statistics, the totals of which in the latter case were only five and seven respectively, may be held to justify the reference we made to them.

Fraudulent Name Plates in China.

In the course of one of his recent speeches, Lord Charles Beresford, whose inborn zeal in the prosecution of any object he undertakes seems to carry him quicker to his point than would seem humanly possible, made the statement that during his journeyings in China he had seen plant and machinery supplied by British makers from which the names of the makers were obliterated and the names of German manufacturers substituted. When Lord Charles Beresford called attention to this circumstance, he was informed that the English firms who made the machinery were too far away to put it right if it should go wrong, whereas the German firms through whom it was supplied were on the spot and ready to execute repairs.

Lord Charles Beresford attached the names of two English firms to this statement, viz. :—Messrs. Sir W. G. Armstrong, Whitworth & Co., Limited, and Messrs. Greenwood & Batley, Limited, with whom we put ourselves into communication, as well as with Lord Charles Beresford himself. Neither Messrs. Sir W. G. Armstrong, Whitworth & Co., nor Messrs. Greenwood & Batley had any specific knowledge of the circumstance to which Lord Charles Beresford had adverted. Messrs. Greenwood & Batley, however, said that as they supplied a considerable quantity of machinery to German buyers, what Lord Charles Beresford alleged might very well be the case : Messrs. Sir W. G. Armstrong, Whitworth & Co., on the other hand, replied that as their name was always cast into the bed-plate of their machines there would be very great difficulty in its obliteration : in fine, Messrs. Armstrong did not appear to attach much importance to the matter to which their attention was called.

It may be pointed out, however, with every deference to Messrs. Sir W. G. Armstrong, Whitworth & Co., that the obliteration of a cast name in a bed-plate and its re-filling and covering with a plate is quite an easy matter, although of course its execution in the case of Messrs. W. G. Armstrong, Whitworth & Co.'s machines is a matter that chiefly concerns themselves. Here we may perhaps quote part of a letter from Lord Charles Beresford to us on the matter. He says :—

"I saw machinery, etc., of British make with the names replaced by those of French and Belgian firms constantly. I particularly remember two machines near Hanyang near Hankow, and some of Whitworth's tools at one of the Arsenals, which had a German name on them. I spoke to some of the Chinese about this matter, and they pointed out to me that it paid them better to get British machines through a local merchant (who was often a German or Belgian, and hence the substitution of names) rather than direct from England, as if anything went wrong they could get the local merchant to accept responsibility and put it right, whereas they had great trouble in the case of machines ordered direct from Great Britain owing to the delays which occurred.

"I am very glad you have taken the matter up, as I think it a most important one for British manufacturers."

We agree with Lord Charles Beresford that the question is an important one for British manufacturers, and are instituting some researches which, we trust, will enable us to ascertain whether this practice is being carried out to any great extent.

An American Consulting Engineer and American Machinery.

In our issue of October last we devoted some space to a consideration of the circumstances relating to the installation of the plant required for the City of Glasgow Corporation Electrical Tramways. We expressed the opinion that English contractors had not been dealt with in quite a fair way by the Consulting Engineer appointed to the Corporation, Mr. H. F. Parshall. The general impression was created at the time that Mr. Parshall had unduly favoured an American firm, to the prejudice of not only English firms but the interests of the Glasgow Corporation itself. No other interpretation could be put on the fact that his recommendation, endorsed by the sub-committee, that the E. P. Allis Company should execute the whole plant—main, and auxiliary engines was over-ruled upon consideration by the whole body of the Council.

Now we do not suppose that anyone will question the right of the Glasgow Corporation, or any other body, public or private, to order their machinery where they please. Nor do we suppose that Mr. Parshall, in throwing the whole weight of his influence in favour of an American firm, was actuated by other than conscientious motives. But as Mr. Parshall has for a long period been associated with an American Company, we think that it would have been policy on his part to have avoided even the remotest suspicion of playing into the hands of friends of his own. We shall, perhaps, in view of later circumstances, be forgiven if we quote our observations on this point. We said:

> Considering the circumstances of Mr. Parshall's position, and those of the appointment he accepted, it will, we think, be generally conceded that it was his duty—if not express, yet at least by implication—to give as much assistance to British engineers as possible in the fulfilment of a British contract. It is possible that it was one of a nature not familiar to them, in the sense that it embodied new practice so far as some of them were concerned. All the more necessary was it on Mr. Parshall's part, therefore, to make his specification as clear as possible, so that every firm should know exactly what was required from them. Judging by the results of the general tender, the only firm which appears to have comprehended Mr. Parshall's requirements was the American firm, the E. P. Allis Company of Milwaukee, who were submitted by him to the Committee as the only people qualified to undertake the business.

As we have stated already, no one questions the perfect right of anybody to send trade out of the country; more especially if they are unable to get the work properly executed at home. This latter point, at the same time, is one entitled to attentive consideration; and, so far as we are concerned, we have no hesitation in affirming our belief that the whole Glasgow Corporation Tramway plant could have been supplied in this country on conditions of equal advantage, to say the least, to those attached to the contract with the United States. We should be the last to cavil at the sending of important

orders abroad were it clearly proved these could not be carried out at home. But was that proved in the case of the Allis Contract? If anything were proved at all in this mysterious transaction, it was the direct contrary.

Now we come to a matter which, taken in conjunction with the circumstances mentioned in the preceding, certainly tends to involve Mr. Parshall in an unpleasant position. We do not attempt to draw any inference from them, but the facts as publicly stated would appear to call for some explanation. They will be found in the following letter, published in our contemporary, *The Engineer*.—The British Insulated Wire Company, Ltd., make this statement:

> In October, 1897, we, with other electrical cable makers, were invited by the Dublin United Tramways Company, Limited, to tender for the cables required in connection with the conversion of their tramways from horse to electric haulage. The specification—written by the Tramway Company's consulting engineer, Mr. Parshall, an American—was issued to us, providing, among other things, that the price quoted for the cables was to be inclusive of the drawing into the conduits in Dublin, and the jointing up and putting to work, and that delivery was to be made of the whole of the cables within nine months of the date of the order. We tendered to the specification in due course, offering to carry out the whole of the terms and conditions set forth in every particular, but received a notification from the secretary of the company on January 29th, 1898, to the effect that our tender had not been accepted.
>
> So far we had, of course, no ground of complaint, but we subsequently heard that the order had been placed with an American firm, the National Conduit and Cable Company, for paper insulated cables, and as we held the patents for this class of material for this country we entered an action for infringement as soon as the first cables were delivered. This action has recently been tried, and has resulted in our favour. During the proceedings it was necessary for the Tramway Company to produce a copy of the contract they had made with the American firm, and it is particularly to this contract that we wish to draw attention. We attach a copy of the contract herewith, and it will be noted that its conditions differ in many respects from those to which the English manufacturers were asked to quote.
>
> Notably the contract is made in America, and the Tramway Company took delivery of the cable in New York, this step being obviously an attempt to deprive the English manufacturer of the rights under his patent. The tram company loaned to the National Conduit and Cable Company the services of their engineer, Mr. Parshall, to supervise the drawing in and jointing, so that this work, although carried out at the contractor's expense, has not been effected by him, as provided for in the original specification. We understood that we were to provide over the lead sheathing of the cables a layer of compounded jute yarn, although for cables that are to be drawn into "ways" it is our practice to provide a plain lead covering only. We find that the American firm have provided plain lead-covered cables, thereby, of course, effecting a considerable saving in the cost.
>
> We would then draw particular attention to the remarkable fact that blanks have been left in the contract, both for the quantities of cable and the sizes and prices at which they are to be supplied. No time for delivery is stated, and, as a matter of fact, the American firm has largely exceeded the time allowed to the English manufacturers. The guarantee clause expressly excludes electrolytic damage, although we were asked to include this possible cause of damage in our undertaking.

A copy of this contract is published in connection with this communication, and bears out in every respect the allegations made.

Lastly, we quote a paragraph from a leading article in our contemporary, the *Scientific American*, of the 11th of November last. This journal says:—

> The latest and most significant instance of our invasion of foreign territory is furnished by the contracts which several American firms have secured for furnishing the plant and equipment for the Glasgow Municipal Tramways. The National Cable and Conduit Company is to supply and build the cables and conduits; the E. P. Allis Company the engines; the General Electric Company the electric fittings, and the first one thousand cars are also to be supplied by an American firm. The total value of these contracts is said to be in the neighbourhood of $15,000,000.

It will be noted that the cables and conduits for the Glasgow electric tramways are being supplied by the National Cable and Conduit Company, the firm referred to by the British Insulated Wire Company, Limited, in their communication. This fact, coupled with others, cannot but give rise to a very disagreeable feeling. We have no wish to criticise in any way Mr. Parshall's methods. He is, as everyone knows, a distinguished electrician and a most capable man of business. What we have to consider is whether these orders have gone out of the country because we are not able to fill them so well as American manufacturers; and that being

the explanation, in what respect or respects are we being beaten? In the interests of British engineers these particulars should be made public, and we think that the Glasgow Corporation should afford an opportunity for their presentation.

Why do we Import Machine Tools?

LYING at the back of, and controlling to a large degree, all engineering enterprise is that important industry which devotes itself to the design and construction of machine tools. The skill of the handicraftsman, which in bygone days counted for so much, is now secondary to, if not quite altogether superseded by, labour-saving machinery. It is, indeed, not too much to say that the nation which possesses the best and the amplest stock of labour-saving machinery must lead the van of progress. Such a position Great Britain has undoubtedly occupied in modern history. Whether she occupies it now is a matter for consideration.

From a general point of view, we look upon the present extensive importation of machine tools into this country with considerable favour. It shows that our manufacturers are getting alive to the exigencies of their position; and their provision, now proceeding at so rapid a rate, of the latest mechanical appliances in their works must result in benefits both to themselves individually and to the country at large.

But, naturally enough, our own tool makers look upon the matter from another point of view; they are inclined to minimise the importance of the American invasion. They assert that just as good machine tools can be got inside the country as outside; and that if people *will* go abroad, it is chiefly due to the fact that the makers here are so overpoweringly busy as to be unable to make even an approach to prompt delivery.

We do not think this attitude one that quite does justice to the question. In the first place, as to the amount of business being taken away from us by American engineers, we do not know that it has occurred to anyone to look into the matter from this standpoint, being one obviously difficult of determination. We have taken the trouble to do so, however, and we find that besides British importers, American machine-tool manufacturers, whose number will probably come as a surprise to many, are now systematically approaching British buyers, largely advertising their products, and presenting every appearance of becoming permanently domiciled in this country. Note the names following, which will all be found week after week taking large spaces in the advertising pages of *Engineering* and the *Engineer*.

William Sellers & Co., U.S.A.
Hendy Machine Co., U.S.A.
Niles Tool Works Co., U.S.A.
Cleveland Machine Co., U.S.A.
Bullard Machine Tool Co., U.S.A.
Newark Machine Tool Works, U.S.A.
Rankin & Ludington, U.S.A.
R. D. Wood, U.S.A.
Pond Machine Tool Co., U.S.A.
R. D. Nuttall & Co., U.S.A.
Pedrick & Ayer Co., U.S.A.
American Tool Works Co., U.S.A.
Pratt Chuck Co., U.S.A.
Newton Machine Tool Co., U.S.A.
Manning, Maxwell & Morne, U.S.A.
Buck & Hickman, Brit.
Chas. Churchill & Co., Brit.

The foregoing names by no means exhaust the stock of American firms who are opening up business in this country: they represent only those who have come conspicuously before our notice. We must take it that these manufacturers find a ready and profitable market for their products in this country, for it is hardly to be supposed that they sink large sums in advertising them here for the mere pleasure of doing so. So far, we think the extent and increasing nature of the trade is not to be disputed. As to why this should be so, our own manufacturers' reply will be that they are already crowded with orders they cannot deal with. So far we may congratulate ourselves; and accepting our premiss to be a correct one, that to possess the finest plant for

manufacturing purposes is a primary essential, we needs must purchase what we cannot make for ourselves. But are we to remain satisfied with this position; and if not, what is the remedy? Before seeking this, however, we must ascertain whether these purchases of American tools are made solely on account of our inability to turn out tools at a greater rate, or whether the orders are going to America because our machines are inferior in design. We are now touching on a delicate point, and probably getting at the crux of the matter, and we are bound to admit that our manufacturers' explanation of the case is not entirely satisfactory. In fact, it is becoming very evident that British makers have not kept pace with their American competitors either in respect to design or in the methods adopted for dealing with the present large demand for tools. Do not let us be misunderstood. We do not admit the inability of our tool makers to cope with this foreign aggression: we only ask for a greater application of that ability to secure for us the orders that are now going away from us. Notwithstanding the great prosperity which British makers of machine tools are apparently enjoying just now, we are far from satisfied with the present condition of affairs, a condition which, in fact, permits of the invasion into our markets of a competitor which it will be very difficult to shake off, especially in the case of a quieter time being experienced; and we believe that our dissatisfaction will be largely shared by our own manufacturers before long. This is, assuming that they continue on present lines; but we venture to believe—and we urge them to seek a remedy here—that they will change their designs in so far as they do not satisfy their customers' requirements, and by extending their capacity for output (which will enable them to carry stocks for exhibition purposes) they will, in fact, meet their competitor on his own ground, and thus be enabled to more than hold their own. To expect, however, to be able altogether to oust the American tool from our midst is not likely, nor is it altogether desirable; but at the same time our position must be such as to secure that our own makers shall never feel the disadvantages, but only reap the advantages, of the importation of foreign machines.

The Paris Exhibition.

THE time is now approaching when the Paris International Exhibition will be formally opened, and British exhibitors must shortly be taking steps to get their exhibits into position.

We are afraid—however the fact is to be deplored—that they will enter on their task with but little enthusiasm. The vituperation with which the British nation is being assailed by the French newspaper press might perhaps be overlooked; as the partly excusable behaviour of a people whose feelings it is known find exuberant expression in moments of exasperation. The stream, however, of personal insult, premeditated, calculated and continuous, levelled at the person of the Sovereign of the British Empire, and which has already caused her son the Prince of Wales to threaten to withdraw from his position as head of the Royal Commission for the British section of the Exhibition, is a very different matter; and unless this outpour of vile calumny ceases to find expression in the Parisian and other French newspapers, the French authorities will discover in due time that we can get along without the Exhibition much more comfortably than the Exhibition can without us; and that although they can abuse us to their hearts' content, with the utmost indifference on our part, yet, for all that, we can hardly be expected to cross over and shake hands with the abusers just for the pleasure of being included in their Exhibition.

We fancy, however—so rapid are the changes that come over French national sentiment—that the violence of the Anglophobism that is now permeating the boulevards will have been mitigated to the point of disappearance considerably before the date on which the Exhibition is fixed for opening. So confident are we, indeed, that the good sense of the French

will ultimately prevail, and that it will cause some notable step to be taken to remove the present ill-feeling before the risk of irrevocable consequences, that we have taken steps to be fully represented at the Exhibition, and in a manner that we venture to anticipate will secure the approbation of our many supporters. The PARIS OFFICE of FEILDEN'S MAGAZINE which we have recently opened, is situated at 249, Rue St. Honoré, at which address every information and assistance will be cheerfully afforded to enquirers by the members of our resident staff.

Whilst we have every hope that the Paris publishing branch of FEILDEN'S MAGAZINE will form a permanent part of its organisation, it has been established in the first instance to facilitate the preparation of the Special Number of FEILDEN'S MAGAZINE to be issued in connection with the Paris Exhibition. We have stated elsewhere that this Number "will form the most magnificent example of Periodical Industrial Literature ever published at any time or in any country in the world's history." This may appear a bold promise, but our readers will find it executed.

Mr. Lloyd Wise's Patent Proposals.

IT is well known that in this country the Patent Regulations, unlike those of Germany and the United States, do not provide for any preliminary examination of patent specifications by the Patent Office officials. The effect, as it works out, of this procedure is curious. Anyone who looks up the Patent records will see strings of patents taken out for the same thing. To give an example: there are, we think, about fifty or sixty patents taken out for the use of spent hops for paper-making. A very large number of others could be cited. Nevertheless, the Patent Office will cheerfully accept as many more patents on the same subject so long as the applicants like to pay the fees. It will strike most people there is something a little unjust in thus accepting payments for no value. It seems something like the selling of out-of-date tickets by a railway company.

Mr. Lloyd Wise—at the present day the main authority on patent matters—has made a suggestion intended to obviate this defect, and it seems to be a reasonable way out of the difficulty. Mr. Lloyd Wise is not disposed to place an excessive reliance on preliminary examiners—though the system, by the way, seems to work fairly well in America. But he theorises with some reason that examiners are not infallible, refusing, sometimes, patents that ought to have been granted: sometimes granting those that ought to be refused.

Mr. Lloyd Wise suggests there should be a preliminary examination for novelty only, and that the applicant should be informed of any prior publications that might seem to affect his claims; but the applicant would not be refused an application on preliminary examination. If he chose he could have it, on condition, however, that references should be given in the specification to the publications advanced as affecting his claims. This method would secure to the patentee all the invention he had made, whilst informing the public as to the limitations of his claims.

It is really hard to see anything unreasonable in this proposal, whilst there is undoubtedly something very unreasonable in the farce of granting patents that can possess no real existence. The chief obstacle to Mr. Lloyd Wise's reform is understood to be that its adoption would diminish the receipts, whilst it increased the expenses, of the Patent Office. This would undoubtedly be the effect of the innovation; and if it is seriously contended that a Government department should continue indefinitely to receive public money without pretending to give value for a material proportion of it, there would be little more to be said. It can, of course, be claimed that applicants can, if they so choose, ascertain, by personal investigation, whether or not their claims have been anticipated. In many cases, however, this is out of the question, owing to distance from the Metropolis and the pecuniary expense

involved. Mr. Lloyd Wise's proposal is one that, as it appears to us, should be adopted. The question of extra expense entailed might be a subject for consideration should it be likely to involve the Patent Office in a loss. But considering that this institution has furnished a large surplus for years—last year's profit, exclusive of a sum of £1,990 odd for "new works," being no less than £122,370 8*s.* 7*d.*—there would appear to be a little margin The working expenses, indeed, for the year ending the 31st of December last were £99,057 12*s.* 10*d.*, whilst the receipts were £223,419. If the Patent Office were a private concern, it would be generally considered as rather a flourishing business.

The Position of Nitro-Glycerine Powders.

We notice it is stated that the United States Government have decided to abandon the smokeless powder manufactured for coast defence by the Dupont Company, the reason being that it seriously deteriorates with keeping, and in certain circumstances is too dangerous to use. This powder, we believe, was the explosive responsible for blowing up the ten-inch gun at Sandy Hook, the gun detonating like a bomb-shell and inflicting great damage. The powder, a true nitro-glycerine powder, contains no vaseline like the British cordite, nor oil, by which, as claimed by Professor Dewar, the compound is softened and detonation prevented. It is, in fact, composed of nitro-glycerine, a considerable percentage of tri-nitro-cellulose (true guncotton) and also a proportion of soluble collodion-cotton, such as is used in making celluloid. The powder also contains a small proportion of urea. The effect of urea, however, is not to prevent the decomposition of the powder, but to mask or disguise the evidence of it. The effect of urea, indeed, is simply to seize on the fumes that are given off by a badly made powder and prevent them showing when the powder is tested. The powder will stand the Abel test when freshly made, but the capacity of the urea to absorb nitrous fumes is not continuous, and after the powder has been kept a short time the nitrous acid fumes show themselves.

There is a feeling all over Europe and the United States at the present time that the nitro-glycerine powders must eventually give place to a true gun-cotton powder. The Germans have long been using Ballistite, which contains 40 per cent. of nitro-glycerine, but they are now experimenting with a view of using a pure gun-cotton powder. France has a powder without nitro-glycerine, a gun-cotton compound with some other substance, not nitro-glycerine. Spain is using a powder without nitro-glycerine. The British Government cordite, with its large percentage of nitro-glycerine, has done very well, not on account of the large quantity of nitro-glycerine, but because everything connected with it has been so very well done, that is, both the nitro-glycerine and the gun-cotton are well made, and the percentage of vaseline being large, the powder has succeeded better than any other kind with a large quantity of nitro-glycerine. Its erosive qualities, however, make short work of the gun using it.

Considerable attention has lately been given to the pure gun-cotton powder made for the United States Naval Service by the California Powder Company. None of this powder has ever detonated or injured a gun, and some remarkable results have been arrived at in obtaining velocities with low pressures equal to cordite. It is stated that velocities with nearly 3,000 feet per second, with safe pressure, have been obtained with a six-inch Vickers-Maxim gun at Sandy Hook, the projectile being long and heavy for the bore. This is rightly regarded as a great achievement, particularly as the powder does not erode the bore to anything like the same extent as cordite. As before stated, this is a pure gun-cotton powder and is the only one which has been found successful in large guns in the United States. This powder is the standard for the United States Naval Service, the Dupont nitro-glycerine powder having only been experimentally used by the Bureau of Fortifications.

"We are, in the vastness of our possessions, losing our grip on national sentiment. It is our duty to maintain intact, and to defend by sea and land, all that our empire builders have left us. The day that sees the defence of the British Empire sapped, sees the disintegration of the Nation's trade and the hands of civilization's timepiece put back 200 years."—Rt. Hon. Lord Charles Beresford, C.B.

A School of Chinese? . . .

We can hardly conceive a more valuable commercial accessory in the present situation than a school of the Chinese languages established in some commercial centre. Just at the present moment, a multitude of young minds are occupied with inspiring dreams of what may be accomplished in the vast, mysterious empire now seemingly about to be thrown open, for the first time in its history, to the enterprise of the western world. China's apparently illimitable resources, her vast natural wealth—material and potential—invest the country with something of the glamour which in former days irradiated India with glories that were far from being unreal. Now, as in times gone by, there is an army of British adventurous spirits waiting to tread in the footsteps of their forefathers, spreading British civilisation, British trade, and British influence throughout this dark area of the world. But in this salutary task we are faced now by conditions far alien to those which encumbered us a hundred years ago. Our way is jostled by jealous, aggressive competition, our motives regarded with suspicion—if not impugned altogether—and obstacles of all kinds set in our path. In former times British trade *followed* the British flag. In these, the British flag has to *drive* it against and through the competition that surrounds it almost everywhere.

It must be evident that under these circumstances what used to be sufficient to carry British trade through virgin territory, where competition at the most was feeble, if not absent altogether, would be utterly inadequate to-day, where we are confronted on every side with eager and not incompetent adversaries. The equipment of our commercial envoys must no longer be confined to their natural abilities—considerable though they are—and a generous stock of British "prestige." Now-a-days we require something more than these, and especially in the case of exploiting a country like China—the largest new market for foreign products the world has ever seen. British travellers hitherto have generally picked up their knowledge and their languages in the country of their origin, with little or no preparatory training. This is no longer permissible. Our travellers and our agents must now enter the sphere of their exertions fully equipped, and ready to start at once on their productive labour. Whilst they may be learning, others are working. First of all essentials, particularly in China, is a general knowledge of the language and its chief variants. There is no reason why a fairly adequate proficiency in these should not be attained in this country by the provision of Chinese Commercial Schools, partly assisted, partly self-sustaining. There can be little difficulty in obtaining competent instructors, and we venture to predict that the establishment of the first school of this character would be followed by such a success as to lead to almost immediate imitation.

Our Expanding Exports . . .

It is pleasing to see that the sum of British exports still maintains its expansive character month by month. The Board of Trade returns for October show that the sum total of every class into which the export returns are divided has increased, the aggregate surplus over the same month in the preceding year being £3,836,002, the amounts being respectively £19,863,019 and £23,699,021.

Thus, as will be seen, the rate of progress to which we referred in some detail in our last issue is being more than maintained. For the ten months of 1899 the gross increase is £25,458,041, which figures are to be reduced by deducting £6,732,101, the computed value of ships built for foreign owners not recorded last year; the net increased value of shipments therefore being for the year £18,725,940.

The most considerable increase is shown in Section B of Class IV., comprising Metals, and articles manufactured therefrom (excepting machinery and ships), which accounts for £1,575,418 of the increase, the totals being £2,775,407 and £4,350,825 respectively. Yarns and textile fabrics have advanced by £754,977, and general manufactures £395,336.

Acetylene as a Motive Power . . .

It is hardly surprising that the wonderful rapidity with which Acetylene Gas has taken a foremost place amongst illuminants has caused attention to be given to its industrial possibilities in other directions. That there is seemingly no valid reason why it should not enter the lists of competition as a motive power, as well as an illuminant, is a suggestion which naturally occurs to many. Several capable experimentalists have gone further than this, and have made investigations which lead one to the conclusion that application of acetylene to motive-power purposes is not only feasible but likely to be justified in actual practice much sooner than at first consideration would seem possible. A number of acetylene motor-cars, indeed, have been already constructed in the United States, and are stated to be working satisfactorily. A perusal of the paper which appears in another part of this issue on acetylene for motive power, from the pen of Mr. Frederick Grover, who has given the subject much study and practical investigation, will place the reader in a position to fairly estimate the chances which, even at this early stage, acetylene indicates of having a future as a power producer. So far, all considerations are not uniformly in its favour (it is hardly in the nature of things that they should be); but the balance of these, particularly as regards the useful experiments made and explained by Mr. Grover, is in favour of the early and successful utilisation of acetylene for motive purposes. The author of the paper is so far satisfied already as to predict for the coming acetylene motor the position of being "the most efficient heat engine yet known." Without going so far as this, it is obvious to thoughtful observers of the rapid development of what may fairly now be termed the acetylene industry that it is not extravagant to assume that the employment of the gas as a motive agency is only one of several promising industrial fields which it is likely to occupy in the near future.

American Bridges. . . .

Amongst papers and discussions recorded in the August issue of the Proceedings of the American Society of Civil Engineers, those bearing on bridge construction occupy no inconsiderable space. The advance copy of a paper, since read, deals with the question of adequate provision for counterstresses, a point which does not always receive the attention its importance demands. Another useful paper is devoted to a comparison of three-hinged and two-hinged spandrel braced parabolic arches, and there is also reported a most interesting discussion upon the wheel-concentration method of determining stresses in railroad bridges, and upon the use of the Launhardt and other fatigue formulas in bridge design.

These are matters of too complex a nature for detailed comment in this column, but we mention them as evidencing the close attention devoted to bridge-building in the United States by civil engineers. To mention one practical result of such discussions, it may be said that over 100 chief engineers of railways have expressed themselves as willing to adopt the Compromise Standard System of live loads for railway bridges when inviting tenders, and to specify that the Equivalent Uniform Method is to be used in computing stresses. This in itself is an important step in the direction of uniformity, but bridge-building firms, who as a body follow attentively the opinions and criticisms expressed by civil engineers, have done still more by elaborating standard methods of production. Nearly all such firms publish standard specifications of bridges, which combine conditions conforming with the most approved recent practice, and these specifications provide every safeguard desirable in the interest of the purchaser. At the same time, however, the conditions cause very little trouble because they are always the same and consequently become matters of mere daily routine. Bearing these things in mind, it is easy to see that bridge-construction is greatly simplified, and that both time limits and initial cost can be materially reduced. Steel of standard sections may safely be kept in stock, the partial construction of girders and other parts may be undertaken in advance of orders if necessary, whilst special tools and standard templates may also be prepared and kept ready for use. In our own country a similar state of things does not prevail: almost every engineer appears to regard originality of general design and of minute detail as a precious privilege. No doubt circumstances are often responsible for divergences, though not to the extent of satisfactorily accounting for the casual variableness which exists.

Steel-Cored Dams. . . .

A RECENT article in the *Engineering Record*, by Mr. Parker, M.Am.Soc.C.E., contains a description of the first dam of any magnitude built in the State of Utah for creating a storage reservoir for irrigation purposes. Increasing population throughout the whole of the United States is producing largely augmented demands for water, and the supplies furnished by natural flow during the irrigation season are practically exhausted by the acreage at present under cultivation. Economy of construction appears to be an essential condition of dam building in the Far West, and as a result some bold, not to say hazardous, designs have been produced. Some Californian arched masonry dams are built on lines which would never be permitted in this country, one of the best known, with a height of 64 ft., possessing a profile measuring only 22 ft. at the bottom and 2½ ft. at the top, whilst the maximum stress, 48 ft. below the crest, is more than 53 tons per square foot. The dam in Utah is situated on East Canyon Creek, where the storage reservoir formed contains 250,000,000 cubic ft. of water. This dam is an example of bold design, and very much resembles the Otay dam, the plans of which were strongly criticised at the time of its construction, a few years back. Notwithstanding this, the dam was completed, and shows less leakage than any other of the Californian dams. At East Canyon Creek, a concrete base resting on bed rock supports the steel core—replacing the usual puddle wall—which is made of 5-16 in. steel plates riveted together. On each side of the core, when in position, a masonry wall was built, leaving two spaces of 4 in. in width. These spaces were filled in with asphaltum concrete rammed hot, so that it formed a bond with apertures in the masonry. Outside the walls masses of rock, solidly packed by falling from a considerable height, complete the embankment, and it should be mentioned that this filling was formed after the concrete base. An open cutting was then made for the erection of the core and of the walls. Events have proved that the concrete lining was wrongly applied, for when the water was allowed to rise the concrete began to leave the plate at the

top until a gap of several feet in width existed in consequence of settlement of the masonry. Ultimately a section of the wall 30 ft. in depth broke away and fell off, but fortunately the damage can be repaired at moderate cost. In the Otay dam a different mode of lining the core was adopted. A layer of concrete was first applied, and the stone embankments were made in such a way that settlement could take place without pulling the concrete from the core plate. No one can desire to discourage originality of design, but deviations from accepted practice should receive the most careful inquiry, especially in the case of structures exposed, as are dams, to enormous stresses. Given proper safeguards, the employment of steel cores for the purpose we have described may be found worthy of consideration by waterworks engineers.

The "Bullfinch" Disaster . . .

A SUPPLEMENTARY inquiry has recently taken place with regard to the connecting-rods of the *Bullfinch*, in the columns of a contemporary, and so far the general concensus of opinion appears to be that inadequate design rather than defective material is to be regarded as furnishing the reason for failure. It was at first suggested that some mystery was involved in the extraordinary behaviour of the steel, and in other words this really meant incomplete knowledge of molecular physics. Up to the present, no conclusive mathematical demonstration has been made of insufficient strength in the connecting-rods, but their condemnation has resulted from comparisons drawn between their dimensions and those adopted in the case of similar parts by other engineering firms. Recent inquiries as to the resistance of steel to tensile and transverse impact throw fresh light on the subject. Judging from results so obtained, the fact is apparently established that the shock resistance of steel and iron to tensile impact bears no uniform relation either to tensile strength or to elongation. Specimens of rolled metal proved by the new method are stated to have exhibited in several instances very low powers of resistance to tensile impact, though their capacities for resisting gradually augmented tensile strains were entirely satisfactory. Assuming the complete confirmation of these observations, it is clear that impact tests upon steel after rolling and forging are desirable in addition to the usual trials, especially when the material is to be used under conditions involving sudden or constantly recurring shocks.

Further, the results recorded point to the probability that new co-efficients will ultimately become available for the purpose of qualifying calculations as to the resisting power of steel. If so, it is not unreasonable to suppose that a solution of the *Bullfinch* problem may be presented, and that the correctness of designs, now approximated by the aid of past practice, may be susceptible of mathematical verification.

British Trade in China. . . .

FOLLOWING on an interesting contribution from Mr. J. Grant Birch which appeared in a recent issue, dealing with the commercial position of this country in China, we have the pleasure of presenting another paper in the present number upon the same subject. This paper forms, we think, the most instructive and interesting deliverance on the subject that has yet appeared in any periodical. In it there are shown the conclusions of a shrewd observer, educated by training and experience for the task he has undertaken, and qualified, therefore, in every respect to pronounce an authoritative judgment on a matter of such supreme importance to the commercial interests of his country.

Mr. Goodwin refers in weighty language to the vast openings which exist for the expansion of British engineering trade in China—openings which, if properly utilised by our manufacturers, will result in incalculable advantage to both themselves and to the country at large. On the other hand, if we betray that lassitude and comparative lack of enterprise which

unhappily has of late been only too characteristic of our dealings, we shall see the opportunities which our statesmen have done so much to create slip into the hands of our rivals.

Pneumatic Tools and Appliances. . . .

THE series of articles on Pneumatic Tools which commences in this number, and which forms part of the series on Machine Tools, will be read, we think, with very considerable interest at the present time. The introduction of these appliances into this country has been of the greatest importance to our shipbuilders and constructional engineers, and we believe that pneumatic tools have an immense future before them. Our American friends have stolen a considerable march upon us in regard to manufacture, yet we cannot but think that British engineers will before long see the importance of putting on the market tools of their own design and construction. Up to the present, however, only one or two firms have made any attempt to compete with the imported article, although we understand an English company has recently been formed to manufacture on a large scale hammers, drills, riveters, etc., and are now equipping a big works in the West of England for this purpose. The patents, however, are American, and part of the company's capital is held by Americans, which we venture to think is not altogether a satisfactory condition of things for British inventors and manufacturers to contemplate. Like almost every new thing that comes out, some objections have been raised against them, but there is little doubt that, as our contributor remarks, pneumatic tools have not only "come to stay," but have revolutionised shop methods and general machine practice. Beyond trade catalogues, and occasional printed matter written in a popular but non-technical style, very little information has been ventilated in regard to these important machines, although much is likely to be heard of them before long; and therefore we believe these present articles will prove of interest and value to our readers, who will doubtless be glad to be informed of the machines at present on the market. In America, of course, they have been used, and their value appreciated for a much longer time than in this country; the same remark might perhaps be made of certain classes of automatic machine tools which have during the last few years found their way over here, and which British manufacturers have found it worth their while to copy and also improve upon. There is one feature, however, in which the pneumatic tool differs from ordinary machine tools, viz., that it is largely covered by patents, and over which it is not unlikely there may be some serious conflict before long, but we think it may end in a standard type being recognised, and even if a patent exists some arrangement will be come to. We strongly recommend the British manufacturer to give this matter his very serious consideration, and hope that before long we shall see on the market pneumatic tools and appliances of all kinds made in Britain and of British invention.

FOR CONVENIENCE IN BINDING . . .

We have arranged that this Number shall complete the first volume of FEILDEN'S MAGAZINE. Future volumes will be completed with the June and December issues respectively of each year. Binding Cases are now being made, particulars of which will be found in the January number. Our readers will now be probably aware of the phenomenal success which has attended the publication of this Magazine, and which might be held to justify its conductors in remaining contented with the present level to which it has attained in technical journalism. We venture to assure them, however, that this is far from being the case, and that 1900 will see improvements in various directions, for some time past in contemplation, with new features calculated to amplify the generous support already accorded it.

Notes.

H. M. Vice-Consul at Archangel kindly sends us a list of firms, with their names and addresses, who are importers of saw-mill machinery, electric light plant, fire engines, steam launches, tugs, &c. We shall be pleased to forward particulars of these to any British firm on application.

We are glad to be able to correct an error, or rather a false statement that has been obtaining currency in the United States through one of the American technical journals. It was asserted in this paper (*Locomotive Engineering*) that the Midland Railway made trials of a Baldwin locomotive against a Midland locomotive, and that those controlling the trials, in order to render the Midland locomotive apparently superior to its rival, reduced the Baldwin locomotive from the 180 pounds pressure at which the Baldwin locomotives were made to work to 160 pounds, at which the Midland locomotive, having two inches more stroke, showed to greater advantage. We find from the Midland Railway, through their Locomotive Superintendent, Mr. Samuel W. Johnson, there is not a word of truth in the statement in question.

We learn that Mr. Joseph Lawrence, the chairman of the well-known Linotype Company, Limited, and interested directorially in a number of other important companies, including the Westinghouse Electrical and Engineering Company, Ltd., is actively concerned in the Edison Ore Milling Syndicate, Ltd. This syndicate is formed, as we are authorised to state, of thirty-six ironmasters and capitalists of England, and it is proposed to utilise Mr. Edison's invention, not only for the extraction of iron ore, but, as soon as the present troubles are over, for the extraction of gold in South Africa.

We have received a lengthy communication from Mr. Hudson Maxim, who writes from Stirling Place, Brooklyn, New York, in which he seeks to traverse some statements made in a note and an article that appeared respectively in our September and October issues, the article being entitled "The Story of Smokeless Powder." Mr. Hudson Maxim appears to resent very much the tone of our article, which we regarded then, as we do still, as being studiously moderate. We cannot quite understand what position Mr. Hudson Maxim takes up in the matter, excepting that he denies that the contribution published under his name in a contemporary under the title of the "Story of Smokeless Powder," is a re-hash of some lectures delivered years ago. Mr. Hudson Maxim says: "I am sending you under separate cover some additional particulars for your examination before publishing this letter. This will obviate the necessity of cumbering this letter with burdensome particulars. I should be glad, however, to forward to any of your subscribers, free of charge, carriage paid, such full particulars."—Up to the date of writing this note, these particulars have not come to hand.

We have received a communication from Mr. G. E. Snoxell, M.I.M.E., in which he takes exception to some of the figures and other data appearing in a recent notice in this Magazine, of the Westinghouse Gas Engine. The whole of the data Mr. Snoxell complains of were supplied to us by the Engineer to the Westinghouse Electric and Engineering Company, who vouched for their accuracy in every particular. Mr. Snoxell, however, must surely be aware that most of the statements made in his communication have been the subject of public controversy for some time past.

Lord Charles Beresford's breezy address to the Institution of Mechanical Engineers on China was keenly enjoyed by the crowded audience which assembled in Spring Gardens for the occasion. The gallant Admiral, it is true, made jokes, and related humorous episodes, but it was felt that the amount of solid information contained in his deliverance amply compensated for a frivolity which perhaps would not be unwelcome in the lucubrations of more distinguished mechanical authorities.

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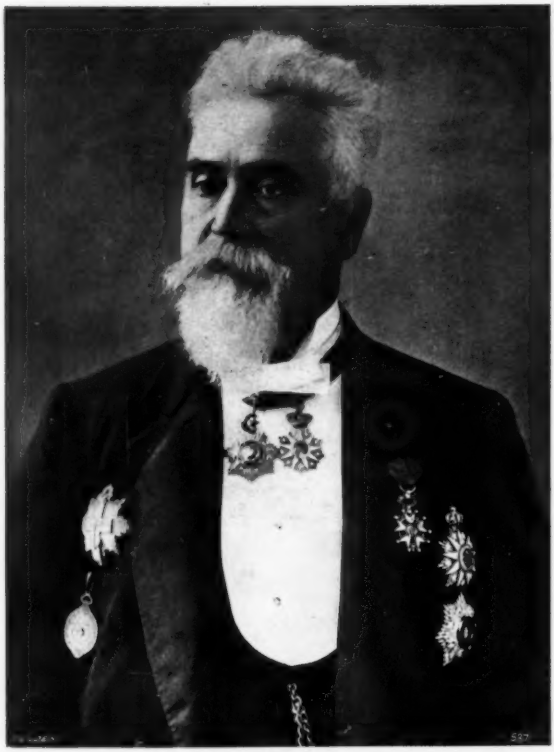
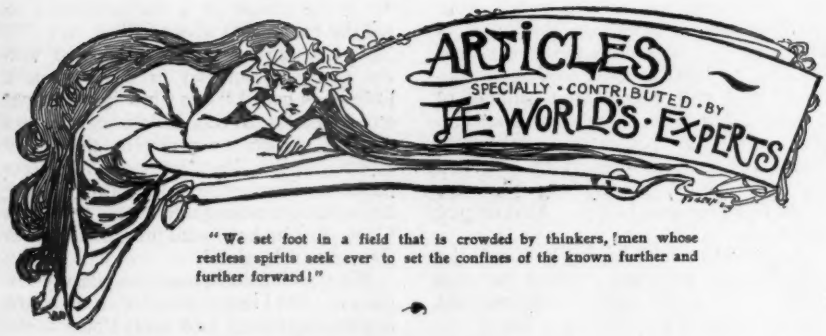


HIRAM STEVENS MAXIM.



"We set foot in a field that is crowded by thinkers, men whose restless spirits seek ever to set the confines of the known further and further forward!"

What Western Civilization and Machinery mean to China.

By HIRAM STEVENS MAXIM.

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MR. HIRAM STEVENS MAXIM'S many claims to distinction can hardly be done justice to, or even barely specified, within the narrow limits of a short prefatory notice. He has attained celebrity as an inventor, a mechanician, as an electrician, an artillerist, and a chemist. He is the author of what may justifiably be described the most perfect and deadly instrument of warfare ever devised. He claims to be the first man who made an incandescent vacuum electric lamp. He is acknowledged to be the inventor of smokeless powders, being the first to combine nitro-glycerine and gun-cotton for that purpose. He has brought mechanical aviation to a higher limit than any previously attained in its history, and is the author of a large number of minor inventions that are not the less valuable because they have been carried into practice without the publicity attached to the more striking innovations of their author.

Mr. Hiram Stevens Maxim, now a naturalized British subject, is a Chevalier of the Legion of Honour, a Member of the Institutions of Mechanical and Electrical Engineers, besides a number of other learned societies, both in this country and the United States. A number of distinctions, too, have been conferred upon him at different times by Foreign Governments.

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A FEW years ago a wealthy French lady offered a large sum of money to anyone who should succeed in opening communication with the people on the planet Mars. Doubtless, a great many of us, without reasoning on the possibilities of such a thing, wished that it might be accomplished; our curiosity was excited. What would we not give to know what the people on the planet Mars, if there be any, are like? If civilized people do live on the planet Mars, their civilization must have been developed quite independently of our own, and their religion, their ideas of morality, and their mode of life, would, without doubt, be found to be totally different from anything that ever has been seen on our planet, Earth. But we are unable—at least at the present moment—to communicate with the inhabitants of Mars, or, in fact, of any other planet.

In the olden time, "the world" meant the Roman Empire, the Roman world,

and this world was said to extend from the "confines of Tartary to the Pillars of Hercules." "Alexander the Great wept because he had no more worlds to conquer," and still beyond the confines of Tartary referred to, there existed an empire which, in population, civilization, wealth and manufactures, vastly exceeded his own empire, or anything that the world had ever seen before. That empire was China.

All western nations, at least of the Aryan race, are closely allied to each other. All have similar religions and similar forms of government. But

CHINA HAS GROWN UP QUITE INDEPENDENTLY

of the Aryan nations. Civilization doubtless commenced in China quite as early as it commenced in Egypt, and while the old Egyptian civilization has passed away, the Chinese system of civilization has continued, without any appreciable changes, for at least fifty centuries. The Chinese differ from us almost as much as they would if they were

INHABITANTS OF ANOTHER PLANET.

In the past they have done all in their power to keep the "outside barbarians" from entering their country. They firmly believed that their own system of government was infinitely superior to anything else in the world, and referred to their own country as the middle kingdom, that is, occupying the centre of the world. The Chinese have probably passed through every stage of religious belief thousands of years ago. Buddhism, Mohammedanism, and Christianity, being of comparatively recent origin, are considered by them foreign faiths, and they have done, and are doing all in their power to prevent these types of religion from being introduced into or extended in their country. The common Chinese look upon us as barbarians and devils. Many of the ignorant people are taught that our Roman Catholics are cannibals. In fact, the popular Chinese ignorance in regard to western nations is only equalled by the popular western ignorance of the Chinese nation. Most of our opinions are doubtless obtained from missionary sources, and it is evidently not to the advantage of the missionary to tell the exact truth about China.

A Chinese statesman connected with the Chinese Embassy in Paris wrote a little book called "Les Chinois peints par eux-mêmes." In this little book he says that of all the countries in the world China is the least known to western nations. He then goes on and recapitulates many amusing errors in regard to China that he has found prevalent in both France and England.

Western business men, especially engineers and those connected with the engineering trades, look upon China as the

MOST BACKWARD NATION IN THE WORLD.

They cannot understand why it is that a Chinaman should not at once adopt western ideas. Why should they not have railways, telegraphs, steamboats, electrical cars, and the hundred-and-one things that go to make up western civilization? Everyone will admit, even the Chinaman, that transportation is exceedingly difficult in China. But the Chinese civilization has grown up on a totally different plan from our own. We might consider, among civilized nations, that the United States of America is at one end of the line and China at the other. In the United States, the Texan kills an ox, sends the skin 2,000 miles to Pennsylvania to be tanned, the tanner sends the leather 500 miles to Massachusetts to be made into boots and shoes, and the Massachusetts shoemaker sends the boots back to Texas. In England, a few years ago, we used to send steel out to the States (3,000 miles), pay 40 per cent. duty to get it into that country, where it was made into twist drills and small tools, and sent back to England again. In China, however, when a buffalo is killed, his hide is tanned and made into shoes on the premises. Every Chinaman knows at least a dozen trades. Each man who has a farm is not only an agriculturist, but is also a carpenter, a blacksmith, a butcher, a shoemaker, a tailor, a weaver, a painter, &c. Each man makes a point of doing everything on his own premises. How few of our own labourers could wash, starch and iron a shirt? Where could

you find a Chinaman that would not be able to do so? With our form of civilization, rapid means of transit are a *sine quâ non*—we could not exist without them. In China, rapid and cheap transportation is of comparatively little importance.

Horace Greeley, in speaking at an agricultural show in the Southern States, said: "that people which can get the most out of the land and of whom the greatest number can live in comparative comfort off a given area, must be considered the most highly civilized people," and he gave, as an example, that New York State, which is about the size of England, was sufficient to support probably not more than 200,000 Red Indians when it was first discovered, but when it became settled by the English, and the land was artificially cultivated, it was found that New York State would support 5,000,000 of white people, which showed that the English system of civilization was much higher than that of the American Indian.

Now, if we gauge the Chinese civilization in the same manner, we shall find that the Chinaman's civilization is of a

VASTLY HIGHER STANDARD THAN OUR OWN.

A French engineer who was travelling in China wrote, in regard to the rape seed oil industry, that the Chinese employed very inferior wooden screw presses in extracting the oil. He said, if they used steam and hydraulic presses, they would get considerably more oil out of the seed, but he admitted that, as the Chinese could raise vastly more rape seed on an acre of ground than a Frenchman, their actual product of oil was considerably larger; moreover, whatever oil was left in the cake made an excellent food for the Chinaman's buffaloes. He also admitted, after extensive travelling in China, that there was a great deal more comfort and prosperity among the agricultural classes in China than in his own country. He admitted that if the French were as skilful as the Chinese in agricultural pursuits, France would be able to support at least double its present population. It has been found in California, that a Chinaman can get vastly more out of an acre of land than any white man that ever lived. The population of China is variously estimated from 300,000,000 to 520,000,000. The actual population, however, is probably about 400,000,000, and these four hundred millions of people are the descendants of a long line of ancestors who have always lived off the soil, and who know all there is to be known in that science. China is a very thickly populated country. In order that this vast multitude should live off the land, it is not only necessary that the land should be cultivated with great care and skill, but it is also necessary that the land itself should be in the highest degree of fertility.

EVERY ATOM OF ORGANIC MATTER

is taken care of and utilized in China. Nothing goes to waste. The Chinaman knows that all effete matter only requires sunlight and labour to convert it into living tissue, either vegetable or animal. It is not so much a question of the area of the territory as of skill and richness of the soil. In our Southern and Western States we often hear of a farmer taking up a new piece of land, farming it for perhaps twenty years, and then, when the land is worn out, as they say, moving on to a new piece. In travelling through the South, I was much surprised at the number of farms which had been worn out and abandoned. Evidently if the Chinese should adopt our Southern civilization, their country

WOULD NOT SUPPORT

400,000,000 of people.

It appears strange to us that when railroads and machinery are so useful to us, anyone in China can be so stupid as to fight against their introduction. But what does the introduction of our civilization and our machinery mean to the Chinaman? It means that their population will be reduced by at least 50,000,000 of people. They say if railways, gas works and machinery are introduced it will

THROW A LOT OF LAND OUT OF CULTIVATION.

They also say that railways will bring litigation and litigation will bring lawyers, and lawyers they don't want.

American and European travellers, on visiting China, are shocked at the filth which is apparent everywhere. Their nostrils are outraged by the nauseating odours. They say that the Chinese have no idea at all of either decency, cleanliness or sanitation, and that our modern system of sewers has no existence in China. The Chinese on their part look upon the

WASTE OF OUR SEWAGE SYSTEM

as criminal folly. The quantity of nitrogenous matter that is discharged by the London sewers would make a whole province in China rich. If the Chinese should introduce our sewers and our sanitary appliances into their country, one-half of the Chinamen would die of starvation during the next ten years.

England can enjoy the luxury of sanitary appliances and still prosper, because England lives off other nations. If all the food consumed by Englishmen had to be raised in England, it is very evident that it would not do to allow any organic substance to go to waste. We should have to do exactly as the Chinaman does. But England itself is a comparatively small country, and obtains the greater part of her food supply by trading with other and larger countries. It is necessary that the food should come from somewhere; someone has to raise it, and as England is a small country there is no trouble in finding sufficient food for her population. But would such a thing be possible in China? If the Chinese should adopt Western civilization and should only be able to produce as much off their land as is produced say in France or England, she would very soon run short of food, and being the most populous country in the world it would be eventually quite impossible for her to draw an adequate food supply from foreign countries.

Chinese civilization is extremely old. China is a self-contained and must remain a self-contained nation. Their system of civilization has been developed in the line of obtaining the most out of the land, and in this they have succeeded to an extent far beyond anything ever known in the world.

It might be said that as far as food supply and giving employment to a great number of workers is concerned, the Chinese system of civilization has been intensified to the

HIGHEST POSSIBLE PITCH,

and the population in China is so numerous at the present time, that this high state of skill and cultivation is only barely sufficient to support the population. Therefore it would appear that any interference from outside nations in the internal economy of the country can only diminish the food supply and lead to the most deplorable condition of affairs.

Western civilization cannot therefore be expected to be beneficial to the Chinese themselves, but the gradual introduction of railways and the opening up of coal and iron mines in the interior of China would doubtless give employment to quite as many as are now employed on the land which would be required by the railways and mines. Railways might also enable the agriculturists in the interior to obtain better prices for their products and this might to some extent be beneficial to the people, but the universal introduction of western ideas, systems and civilization into China cannot fail to produce a great falling off in the food supply, and, as is well known, the falling off of the food supply of a great nation leads to deplorable results.

Hiram Stevens Maxim

Development of China and British-Chinese Trade.

By GEORGE A. GOODWIN, WHITWORTH SCHOLAR, M.I.C.E.

MR. GEO. A. GOODWIN was born in Canada, but has acquired a wide range of important experience in this country, on the Continent, and in the East. He has been associated with the Thames Ironworks and Shipbuilding Company, Sir John Fowler, and Messrs. J. & E. Hall. He is an authority on engineering constructional work and refrigerating machinery. Mr. Goodwin is a Member of the Institution of Civil Engineers, and a year or two ago made a professional tour round the world. Some of the results obtained in the course of this, appear in the following article.

THE question of the development of China and the expansion of British trade there, and in the Far East generally, is such an all-absorbing one at the present time, and one I am so much interested in, that it was with the greatest pleasure I accepted the invitation to write an article on the subject for this well-timed periodical.

Since my recent return from a long professional tour in China, Japan, the Straits, Siam, and India, I have observed with much gratification and deep interest that our commercial relations with China are, though late, receiving more and more the attention which they deserve from our Government, manufacturers and the public.

No country that I have visited offers such vast openings for the expansion of our engineering trade as China—not only in the construction of railways, waterworks, artificial lighting, and improving waterways (all of which are of public and paramount importance, and pioneer developments that must precede a real advance of any country), but in the installation of new industries, mining operations, and the adaptation of general mechanical appliances and machinery, and it is with the earnest desire of seeing some sound progressive movement made by our manufacturers—or those that represent them—that I pen this article.

The much-talked-of "open door" being now apparently closed, so-called spheres of influence having taken the place—it becomes imperatively necessary to take such steps as shall ensure our having a fair proportion of the trade with China; and apart from any active interference from our Government, it behoves our manufacturers and trade generally to unite and lay down some definite plan of action, and above all, follow it up with the firm determination to supply articles that are *wanted* and asked for, or even that may have to be specially manufactured, so as suit the native requirements.

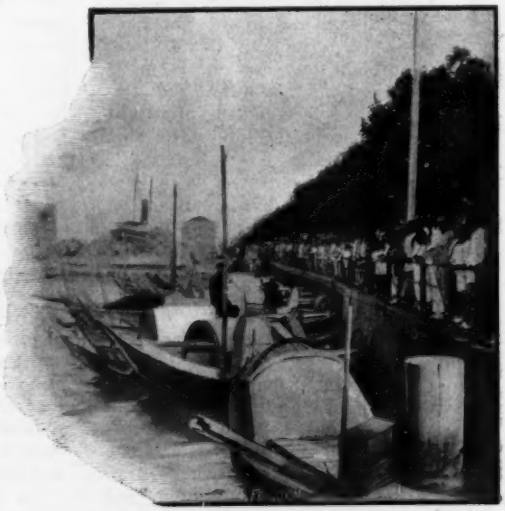
In a letter I wrote to the *Daily Telegraph*, and which appeared in the issue of the 13th June, 1898, I advocated,

DECORATIVE ARCH ON THE BUND, SHANGHAI, DIVIDING THE ENGLISH FROM THE FRENCH CONCESSION. (PHOTO A.)

amongst other matters, the establishing of a floating exhibition, which could go from port to port, and so enable our many manufactures and special machinery to be seen in actual work by a good proportion of the natives; this idea has, with the usual prompt appreciation of the foreigners, been adopted by the Austro-Hungarians, and supported by their Government, so that our usual lethargic disposition has allowed others to get ahead of us.

It is generally supposed that the average Chinese, individually, do not care to take up innovations or see them introduced, but this supposition is erroneous when they apply, as they would do, to the increase of their general trading, and general welfare. When it is once demonstrated to them that the use of machinery and Western methods could be carried on at a profit, to their pecuniary advantage and comfort, they would be found quite ready to adopt them; the great difficulty is to get them at the outset to thoroughly understand and appreciate the advantage accruing by the use of the various machines and industrial plants. Naturally, all being new, many of them cannot understand drawings, or even photographs, so what is wanted to effect this are working models and working plants on a small scale.

It is a natural trait of the Chinaman to want to "look see" everything before he will purchase. If you speak to, say, even an educated Shanghai merchant about a complicated plant, such as for weaving cloth, he would reply, with the usual bland celestial expression: "Can you gettee me one Shanghai to look see?" so, somehow or the other, he must be put in a position to understand and appreciate what one wishes him to



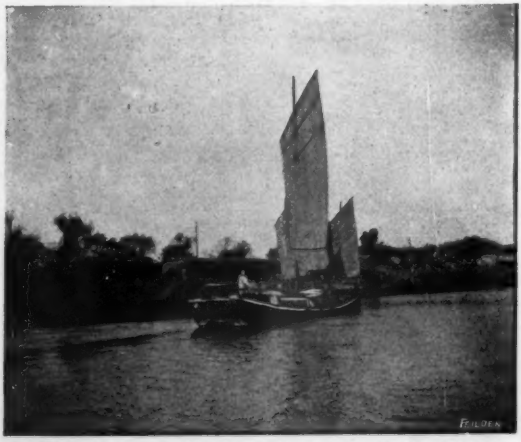
TYPES OF SAMPANS LYING ALONGSIDE THE WHARF AT SHANGHAI (PHOTO B.)

purchase before he can be induced to give an order.

Railway systems, both native and foreign, can now be said to be fairly started, offering facilities for the exchange of produce and manufactures between interior cities and the coast, so we can look forward with confidence to the gradual expansion in the use of machinery, whether it be hand-machines for small manufactures, working of mines, steam traffic on inland waters, use of electric light and steam-worked industries, the extent of which it is impossible to over estimate.

COAL BARGES COMING ALONGSIDE TO COAL SHIP AT CHEFOO, AND TO LOAD AND UNLOAD CARGO. (PHOTO C.)

One most important fact always to be remembered in connection with the Chinese, is their conservatism. For instance, when a Chinaman has purchased articles to any extent and been satisfied with them, those articles will always be associated in his mind with a particular "Chop" (brand, shape, or name), and it will thenceforward be the most difficult matter imaginable to get him to buy similar articles of other "Chops" (makes): so the importance of being first in the field, getting ahead of our competitors and firmly establishing our "Chops," becomes at once apparent. Certain "Chops" of goods introduced to China years ago still hold their own against all opposition, even though the modern ones be better and cheaper.



METHOD OF WATER-BORNE GOODS TRANSIT BETWEEN PEKING AND TIENTSIN. (PHOTO D.)

The ordinary Chinese merchant is a thoroughly reliable man; he may take a long time to make up his mind, but having done so, his word is as good as his bond. He is very keen and smart in driving a bargain, but having made it he will carry it out to the letter, even if the market should have gone against him; in this respect he is far ahead of the Japanese, who have a great deal to learn in business morality, and who think nothing of refusing to carry out a contract, or take up goods ordered, in the event of their

THE FERRY AT TIENTSIN. (PHOTO E.)

anticipating a loss. How they will act now the new Treaty has come into force remains to be seen, but it was only a short time ago that such conduct was rife, and when the foreigners (Europeans) took a case into the court and won the day, the Japanese combined and pronounced a boycott on the firm if they insisted on the carrying out of the award of the court.

One most important matter in connection with engineering work supplied to Japanese or to European merchants for shipment to Japan, is that on no account whatever should our manufacturers agree to accept inspection *in* Japan, or in fact anything short of inspection and *final acceptance here*, and by one who thoroughly understands their requirements.

During my long stay in Japan, I saw and heard a good deal of Japanese customs and methods that make me feel very strongly on this point, and my readers will be able to form some notion of the accuracy of my deduction when I state that in connection with some large deliveries of C.I. water-pipes, young cadets or engineering college students were requisitioned to examine them, which they did most energetically with magnifying glasses, with the natural consequence that over 50 per cent. were rejected for supposed defects, to which no European with even mediocre experience would attach the slightest importance.

One thing much needed in China, and by the way also in India, is small hand-power machinery which could be used in the native homes; for example, weaving machinery, spinning frames, rice cleaning, flour grinding, and probably many others that would at once suggest themselves to any intelligent engineer who should devote himself to the study of native habits and customs on the spot.

One of the greatest hindrances in the past to the more rapid increase of British trade, was, and still is, the extreme apparent reluctance of our manufacturers to even endeavour to supply the *exact* requirements of their foreign customers when such requirements do not conform with the particular type of work they are accustomed to turn out.

It is here that our competitors, particularly the German and American, so far excel us, as they are not only willing but anxious

METHOD OF CARRYING LONG RAFTS OF LOGS UP STREAM. (PHOTO F.)

to make any alteration to their usual manufactures with the view of establishing a "Chop," but will even suffer a loss on the transaction with the hope of getting the bulk of the business later on.

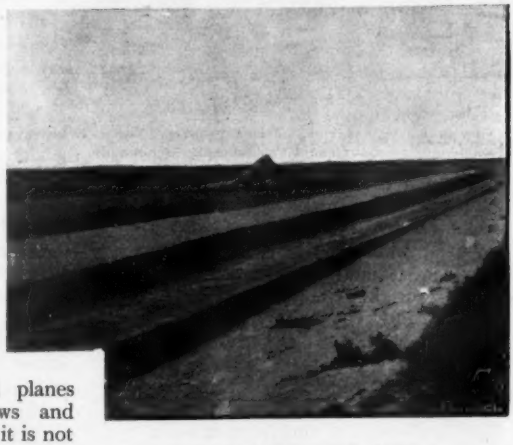
Again, it is of frequent occurrence, when a carefully worded indent is sent over from abroad asking for certain specified articles and information, for the manufacturers to tender on entirely different lines, even venturing to suggest that the intending users do not require such types of special machines, and further, actually defining what they do want; and as for the Chinese obtaining replies to information asked for, it is quite the exception to get it.

It is almost impossible for manufacturers here to understand all the conditions of working that exist abroad; machines that answer well in this country are sometimes most unsuitable for far Eastern ones, and in many cases the buyers are forced to buy German and American manufactured machinery, entirely due to our manufacturers trying to force on them articles they do not ask for or require.

When one considers that the Chinese use hand-saws and planes backwards, fix hand-frame saws and move the wood across the blade, it is not difficult to believe that their requirements are quite different to ours. Take again the case of a sliding and screw-cutting lathe: give this to a Chinaman, and all the persuasive powers imaginable will never get him to use both methods of feed, viz., rack and screw; he would get accustomed to use, say, the screw-cutting, and the sliding gear will be all so much waste.

When our manufacturers are asked to send out full particulars of, say, a certain lot of plant or machinery, why is it they so seldom take the trouble to place themselves in their correspondent's position and consider, if they can, what information they would be likely to want themselves if placed in similar positions?

A case in point came within my own personal experience during my trip. While *en route* for Vladivostock, I met a Russian who was the owner of some 100 acres of land containing oak trees which had been submerged for a great number of years. This gentleman being desirous of starting a factory to cut up the timber into planks, boards, and veneer, and this industry being entirely new to him, he consulted me. I then wrote fully to one of our leading saw-mill machine manufacturers, gave them *complete* particulars of what was required to be done, and requested them to send out to



GRAVES CLOSE TO TIENTSIN. (PHOTO G.

my friend a *full* estimate and particulars, giving prices for each machine, stating its output, horse-power required, price, &c., weight and shipping measurements; also to send photos of each machine, so that the proposed buyer could have all the facts before him and be able to plan out the works, estimate the amount of land required, and the total cost—but it will hardly be credited when I state that the only attention given to this *bonâ fide* inquiry was to send out one of their *ordinary* catalogues, without any comments whatever, and asking my friend to write back and say what machines *he* wanted, after which

VIEW OF RAILWAY STATION, SHOWING "SALT-TAX" SOLDIERS ON THE LOOK-OUT FOR SALT SMUGGLERS. (PHOTO H.)

they would be pleased to submit an estimate.

Again, while in China, I secured, on behalf of some manufacturers here, an order from the Government for several engines, and sent it home for execution with a signed contract, arranging, as a precautionary measure before I left, that a highly responsible European firm should handle the material on its arrival abroad, receive the money, and remit it home.

On my return to England, what did I find? Why, with our manufacturers' usual short-sightedness in regard to future orders, they had refused the contract on account of the last one-third of the purchase-money being withheld for two months after *arrival* of the goods; the result of this was most disastrous, as it not only led to the order for these engines and a *large* number since going to the Continent and America, but led to the determination of the Chinese not to purchase this class of machine in England for the future, and has even led to their establishing a workshop of their own to manufacture for themselves.

Here is clearly an example of how our makers persist in continuing on their way of doing business, instead of endeavouring to meet their customers' views and customs (the latter it is particularly necessary to study), and this they will have to do if they desire to increase their trade.

The Chinese Government have had, and do have, these terms of payment always agreed to by our foreign competitors; and, when I was in Peking, all the world were competing for this work, which I obtained through personal influence, with the satisfactory understanding that if they proved efficient they would be made a type for future adoption. Is it any wonder, in the face of such neglect, that our foreign trade is leaving us?

There is no doubt that we, as a manufacturing nation, are most unaccommodating, and are just as uncompromising in our desire to adhere to "old-time custom" as we say the Chinese are.

It is all very well for the moment for our works to be careless of new foreign orders, and to refuse to submit designs or tenders for anything the slightest bit out of their usual line of manufacture, as is being done every day, because there happens to be a glut of trade; but what is happening? Foreign orders are being constantly sent to other countries for execution, and when a slack time comes, as assuredly it will, our manufacturers will indeed be looking for work when there will be none to get, it having been driven away by their own short-sightedness.

No doubt, a lot of the work that has recently gone to the States, in competition with us, was the natural outcome of the unfortunate, badly planned, and badly timed engineers' strike; but the masters' methods are also responsible for a good deal.

To recover our lost trade in the East, we must conform to the ways of the Asiatics, where such ways are accepted by our foreign competitors, and properly protected by responsible agents on the spot.

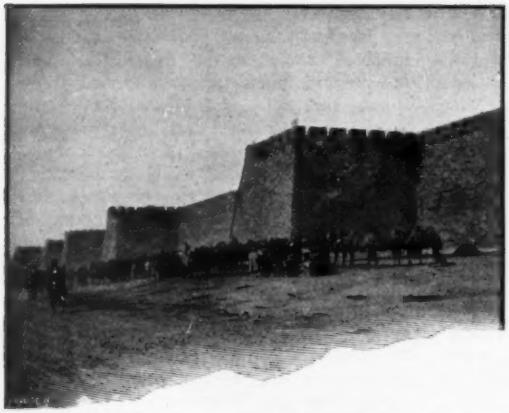
We must be willing to make new designs, if necessary; submit specially prepared new samples where asked for, even if at a slight loss; pay close attention to buyers' requirements, and particularly to their inquiries—and they must not expect their correspondents to be able to send home full specifications with everything detailed out, as frequently they are not able to obtain the information which a specialist manufacturer could easily determine for himself.

Take a case where, perhaps, some engineering native establishment might require a heavy crane, or shear-legs; they go to one of the foreign resident merchants, who sends home for a tender; he gives weight, and height to be lifted, overhang of jib outwards and inwards, but probably does not specify the speed of lifting. In a case like this, surely it is not too much to expect a crane builder to fix a speed and quote it in his tender—but no, on more than one occasion I have been told by friends abroad, manufacturers write out and ask what speed is desired, as they might quote for a faster one than their competitors, entailing heavier and more powerful driving gear, &c., so they lose the opportunity to quote, and the order goes abroad.

Surely it would be far better and more sensible to quote for one speed, whichever they consider most suitable, and give approximate additions and deductions, in case it were increased or diminished. It may happen that a native, say a Japanese or Chinaman, is desirous of opening up some new industry or industrial manufacture; he goes to a merchant, who in his turn writes home direct to the makers, asking for all preliminary estimates, particulars of each machine, &c. But what do they do? They write back and say they cannot quote without knowing the amount of raw material to deal with per day (even then, perhaps, not indicating that a day can be anything from eight to twenty-four hours), the amount of finished articles to be turned out, and other—one must own—important questions, but only important when the time comes to order; at the same time I have no doubt they mentally "bless" the foreign merchant as being bereft of common sense. They thus initiate two or three months loss of time, a feeling of irritation is set up on the part of the native, who thinks *we* ought to know, and the customer abroad gets disgusted with our unaccommodating ways, writes over to a German or American firm, gets two or three estimates, based on various outputs, back by return of mail, and the order finally goes to them.

It is a fact patent to everyone that the days are long since passed when we had the pick of foreign work; what with the development and refinement of modern machinery, lessening the value and necessity of skilled labour, the increased skill of foreign workmen—when it is required—their lower wages and longer hours of work, combined with the constantly increasing competition and the general desire for cheapness, it is time for our

TYPICAL CHINESE RAILWAY STATION AND TRAIN. (PHOTO J.)



CAMELS OUTSIDE THE WALLS OF PEKING PREPARING TO START FOR THE COAL MINES TO FETCH COAL. (PHOTO K.)

workmen to realise that they are *not* the only skilled ones available, and if they desire that we should maintain our past reputation as educators and pioneers of engineering, and with it our proportionate share of the trade, they will have to see that a greater output is obtained per man per hour, and welcome and use to its fullest extent all labour-saving machinery that their employers can obtain, with the ultimate object of turning out work at a quicker and cheaper rate.

Time and price in the present age are almost the most important factors, and very frequently are the questions on which the final placing of contracts depend.

I now venture to refer to a few of the Chinese customs, illustrated with photographs which I took on the spot at Shanghai, Tientsin, Peking, and surrounding country, from which one can readily judge of these peculiar people, as well as the great amount of ingenuity they frequently exhibit.

BOY HARNESSED TO A LOAD OF COAL. (PHOTO L.)

SHANGHAI.

Photo *A* shows a decorative arch on the Bund dividing the English from the French concession, being decorated on the occasion of the 24th July.

In the foreground will be noticed the ordinary one-wheel barrows, in which passengers are carried for miles, or for transport of goods. In fact, the whole vehicular movement of goods from ship to go-downs (warehouses) or *vice versâ*, is done in this way.

It may here be noted that four-wheeled vehicles are never used in China, and the two-wheel carts that are used, have frequently very long bodies on which the goods are piled up, very carefully balanced, so as not to throw any upward or downward pressure on the horse, while frequently the driver perches himself on the top and, by his position, balances the whole.

The highly-educated Chinese, where environed by Europeans, takes his pleasures in much the

same way as we do; in Shanghai and Singapore, particularly, they are to be seen driving in really well turned out carriages and pairs, and going to and from their summer gardens.

Photo *B* shows the types of sampans lying alongside the wharf at Shanghai, and which are used for ferrying purposes.

Photo *C* shows coal barges coming alongside to coal ship at Chefoo and to load and to unload cargo.

Photo *D* shows the methods of water-borne goods transit between Peking and Tientsin.

Photo *E* shows the ferry at Tientsin; this is simply a plain rectangular barge with a pole in the centre, to which a wire rope is attached, the other end being anchored to the centre of the bed of the river. Then by simply casting off from the shore in the direction of the current (which is always in one direction), the boat describes a semi-circle, and by the use of the rudder is made to strike the opposite shore.

Photo *F* shows how long rafts of logs are carried up stream; at the head is attached a vertical winch, worked by hand, and hauls on a rope two or three hundred yards long, the outer end being attached to an anchor; when all the rope has been wound in, a man in a boat pulls up the anchor, rows out the full length of the rope, drops the anchor, when the hauling is again proceeded with.

One frequently hears of objections raised by the Chinese to the placement of a railway owing to its interference with their dead, who are buried all over the country.

Photo *G* shows a large number of such graves, indicated by mounds of earth, which is a view taken close to Tientsin. Cash, however, soon overcomes these objections, and I was told by a responsible engineer on the Imperial Chinese railways that during the construction of the line, when it was known that the graves interfered with would be paid for, there was quite a rush to sell ancestors, and more than this, bogus graves were even manufactured, which, on excavating, were found to contain no signs of bodies whatever.

Photos *H* and *J* show railway stations and trains, the former with "salt-tax" soldiers on the look out for salt smugglers.

Photo *K* shows hundreds of camels outside the walls of Peking just preparatory to their start for the coal-mines to fetch coal. It is a peculiar fact that the whole of the coal used here is carried for 8 to 21 miles in sacks on mule, donkey, or camel back.

WELL OF DRINKING WATER IN FRONT OF THE BRITISH LEGATION, PEKING. (PHOTO M.)

I visited the Wung Deak Tzwen Erl Mine (eight hours' journey from the city), and here saw mining in its most primitive form. The entrance was from the side of a hill, and consisted of a tunnel hardly high enough to walk in, having a continuous slope, with small-diameter logs of wood, all greasy and slippery, laid down about 12 in. apart; the boys who carry the coal are naked, and at many places have to walk on their hands and feet,

pulling behind them 1 picul (100 catties = 133 lbs.) of coal in a small flat oval basket shod with iron runners.

This is very arduous work, and they have often to rest for breath on each up journey; after passing the air-lock door at the top and emerging on to the surface, the coal is weighed over a steelyard, when the boy re-harnesses himself and takes the coal out—(see Photo *L*)—on to the heaps, and deposits it according to its quality, decided by an overseer.

The coal is sold at the mine for 10 cents (100 cents = $1, about 2*s.* 1*d.*) per 130 catties = 173 lbs. (equivalent to $1\frac{30}{100}$ a ton: this is for coal-dust; for lump coal the price is double), and is sold in Peking for 45 to 90 cents, viz., $5\frac{85}{100}$ to $11\frac{70}{100}$ a ton.

Camels carry 400 to 500 lbs. each, mules 250 lbs., and donkeys 150 lbs., the cost of carriage to Peking by camel being about 20 cents (5d.) per picul.

The ventilation of the mine is done by a small fan worked by foot by a boy, who does this incessantly for ten hours at a stretch, taking his meals at his post.

There was a small Worthington pump close to the bottom of the mine, but, Chinese-like, placed just too high up to enable it to draw, the consequence being that two sets of men had to be engaged in ladling the water up two stages to supply the pump suction.

Photo *M* shows one of the drinking-water wells just in front of the British Legation in Peking; this shows the water being raised by pail and rope, emptied into a small receptacle, and then running through a bamboo pipe into a small donkey water-cart.

These few remarks will bring more vividly to the imagination some of the directions in which Western methods might be of service to the Chinese, and to which our manufacturers could usefully apply themselves.

Gerard Goodrum

A Foreign Invasion.

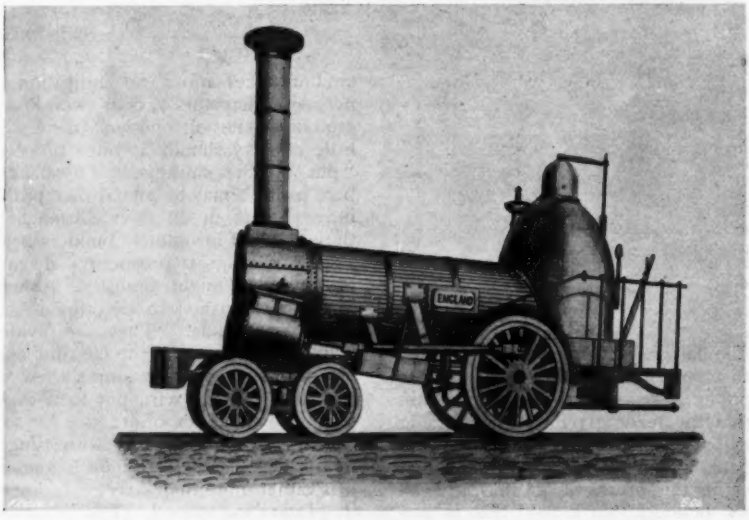
By GEORGE FREDERICK BIRD.

MR. GEORGE FREDERICK BIRD has for upwards of twelve years devoted a considerable amount of attention to questions of steam locomotion on land and sea, technically and in their historical and industrial aspects. During that period he has been a frequent contributor to some of the leading engineering journals of this country and the United States.

IF the daily newspapers can be accepted as affording a faithful mirror of the public taste, there can be no doubt that the reading public rather prefer to be scared than otherwise. So much has been written, and published, recently, respecting the invasion of American locomotive builders into a field that is presumed to have been hitherto closed to all but home products, that the average reader of newspapers, who knows no more than he gathers from his own pet "organ," might quite excusably infer that the knell of doom, with respect to at least one of our industries, has sounded in unmistakable tones. Indeed, a melancholy sort of satisfaction seems to be derived from this supposititious catastrophe, and it is at the risk of incurring unpopularity by dispelling this mournful prognosis that the writer proposes to show, first, that the importation of locomotives to work on British railways is not a new event, and, secondly, that if it were, the existing circumstances afford no indication of a necessity that the various world-famous establishments of builders in this poor little country should at once proceed to "put up the shutters." To speak the bare truth, it may be stated that probably never before in all their existence have these firms of locomotive builders been in a state of so great prosperity—disgusting prosperity, it might almost be termed, if a Socialist wished to describe it—as at the present time. They are evidently realising the vision of the fat kine, after a certain experience of leanness a few years ago, and they are hard put to it to keep pace with the influx of orders.

So far from this year witnessing the first invasion of foreign-built locomotives, it is rather more than sixty years since the innovation was started. The Birmingham and Gloucester Railway, which is now incorporated in the wide-spread Midland Railway system, was opened for traffic on June 24th, 1840, and the engineer, Captain Moorsom, had laid it out so that between Bromsgrove and Blackwell, for a length of more than two miles, there was a portion of line rising at the rate of 1 in 37, known as the Lickey incline. In the then existing stage of locomotive development, this was a somewhat daring piece of engineering, and it is doubtful whether there were many British locomotives of the period capable of tackling this stiff ascent with a train in tow. At all events, the directors of the line entered

into correspondence with an American builder of repute, Mr. William Norris, of Philadelphia, the founder of the firm of Richard Norris & Son, with the result that an agreement was entered into that the latter should supply a number of engines which were to be "of a higher power, greater durability, and less weight, than could be obtained in this country. They were to be subjected to 15 trials within 30 days, and prove their capability by drawing up a gradient of 1 in 330 a load of 100 tons, gross weight, at a speed of 20 miles per hour, and up a gradient of 1 in 180 a load of 100 tons at a speed of 14 miles per hour." Subject to the success of these tests, the company undertook to accept a certain number of engines at from £1,500 to £1,600 each, including 20 per cent. import duty. So far as can be gathered from published records, these engines were not designed specially for working the Lickey incline They were, in fact, more or less, "standard" American locomotives of the period, as the recent importations of Midland engines are "standard" patterns of the present day. The accompanying illustration, which shows the "England," one of the first to be delivered, gives the idea of anything rather than a typical "hill-climber," for the engine was of light weight, and provided with only a single pair of driving wheels. It will be noted, however, that she was fitted with a leading four-wheeled truck or bogie, even at that early date a fundamental feature of American design. The cylinders of the first three engines were 10½ ins. in diameter, with a stroke of 18 ins., the bogie wheels were 2 ft. 6 ins., and the driving-wheels 4 ft. in diameter, respectively, and the weight of each engine, exclusive of the tender, was only 9½ tons. Before being accepted by the Birmingham & Gloucester Railway Co., the engines ran a course of trials on the Grand Junction Railway, and apparently failed to satisfy fully the tests imposed. In the end, however, they were accepted, and others of slightly greater power were afterwards put to work, to the number of 17 in all, though the names of



THE "ENGLAND," ONE OF THE FIRST AMERICAN LOCOMOTIVES SENT TO THIS COUNTRY.
BUILT BY WILLIAM NORRIS, PHILADELPHIA, FOR THE BIRMINGHAM AND GLOUCESTER RAILWAY, 1840.

no more than fourteen have been handed down to posterity. The fourteen thus distinguished were :—

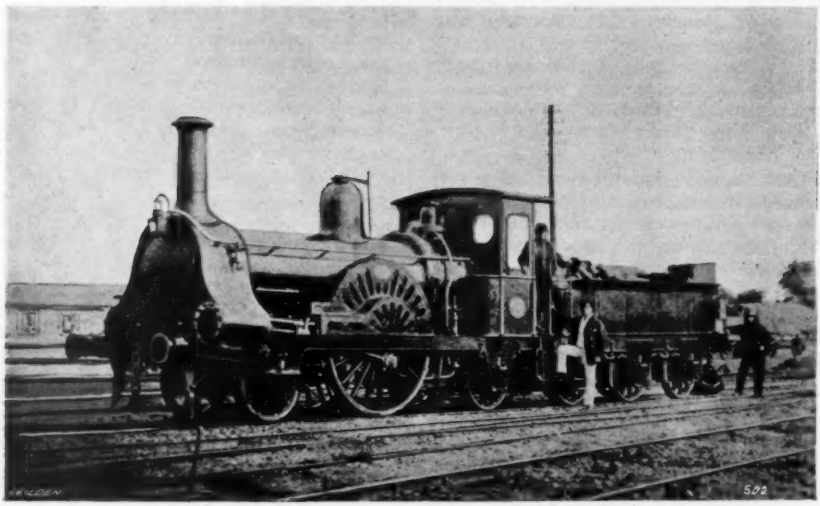
"England."	"Gloucester."	"Baltimore."
"Columbia."	"Ashchurch."	"President."
"Atlantic."	"Blackwell."	"Niagara."
"Philadelphia."	"Washington."	"New York."
"Birmingham."	"Boston."	

After a short time these engines were considerably improved by being deprived of their tenders, being all rebuilt with a water-tank over the boiler and coal-bunkers on either side of the fire-box, this change having the effect of increasing the weight to 14 tons apiece, of which about 10 tons was allotted to the two driving-wheels. Subsequently they were, of course, supplanted by British engines possessing greater suitability and enhanced power, and shortly after coming into the hands of the Midland Railway Co., in 1845-6, they were "broken up" at Derby. All the same, they seem to have been more efficient at the date of delivery than the contemporary British engines against which they were matched. There is a story that Mr. Edward Bury sent an engine to compete with them on the Lickey incline, and that his locomotive had to come back ingloriously after getting half-way up the ascent.

After this incursion, no more "foreign" engines came to British railways for about a quarter of a century. The Great Eastern was the next transgressor in this respect, by giving orders for sixteen engines to the firm of Schneider & Co., of Creusôt. It is to be presumed that British builders were fully occupied with orders at that time, as now, for these were apparently "overflow" orders, other locomotives of the same types being under construction in this country simultaneously, and the "foreigners" were constructed strictly in accordance with the designs of the Locomotive Superintendent of the line, Mr. Robert Sinclair. They were of two classes, intended for express passenger and express goods traffic respectively, and are shown as originally built in the accompanying illustrations. It will be seen that the passenger engines were of what is known as the single-driving type, having a single pair of large driving wheels, 7 ft. $1\frac{1}{4}$ in. in diameter, with two pairs of smaller "carrying" wheels at the leading and trailing ends respectively, and the engines weighed, exclusive of their tenders, 31 tons each, of which the driving wheels were apportioned about $13\frac{1}{2}$ tons. Messrs. Schneider & Co. built six of these engines, which were practically exactly similar to a number constructed in this country.

The "express" goods engines were of a somewhat novel type, as can be seen, being approximately similar to any ordinary four-coupled passenger locomotive of that or later date. Ten of these, out of a total of more than 100, were built at Creusôt in 1865, with driving wheels 6 ft. $1\frac{1}{4}$ in. in diameter, and a total weight, excluding the tender, of about $32\frac{1}{2}$ tons. It may be noted that none of these engines can be seen nowadays on the Great Eastern Railway, at all events in their original condition. The passenger engines have only disappeared within the last few years, however, though they were at the close of their career somewhat different in form from the appearance presented in the photograph. A few were quite rebuilt, with a four-wheeled bogie in place of the single pair of leading wheels. Thirty of the "express" goods engines were similarly rebuilt, some of the number being the "foreign" engines, and one or two so transformed may perhaps still be seen on the line. Two, at least, were employed in shunting work at Liverpool Street Station until recently.

Our record of "foreign-built" locomotives again has to bridge a considerable lapse of time. In 1881 there was a new importation from America, though on this occasion it was a single spy, not a battalion. Forty-nine years previously, Matthias W. Baldwin built at Philadelphia the first engine of the long series which has since been associated with the Baldwin Locomotive Works in that city, now under the proprietorship of Messrs. Burnham, Williams & Co. March, 1880, saw engine No. 5000 turned out from those famous works, and it was, appropriately enough, an engine of somewhat novel design. Contrary to the prevalent American custom, this locomotive had only a single

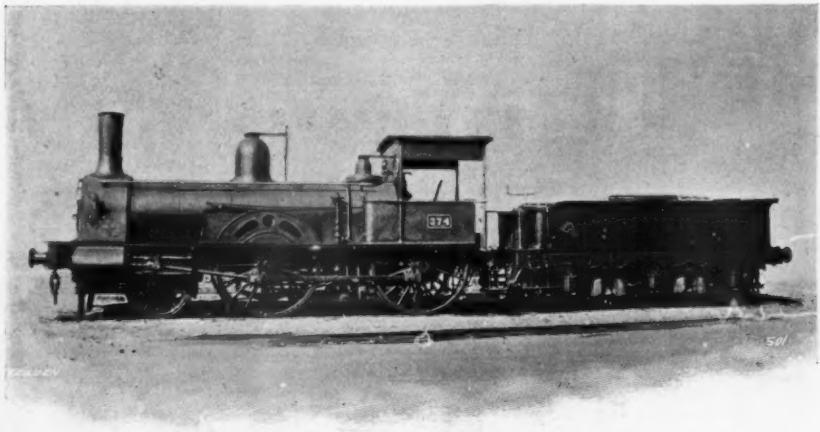


ONE OF SIX STANDARD EXPRESS PASSENGER LOCOMOTIVES BUILT FOR THE GREAT EASTERN RAILWAY BY MESSRS. SCHNEIDER AND CO., OF CREUSOT, IN 1865.

pair of driving wheels, with a leading four-wheeled bogie and a pair of small trailing wheels under the firebox. An ingenious arrangement of levers, actuating the springs of the driving and trailing wheels, allowed the engine-driver at will to alter the weight on the driving wheels from a normal amount of about 15½ tons to a maximum of 20 tons, so as to vary the weight available for adhesion according to the load to be drawn. Another novelty, more particularly as regards this country, was the adoption of a Wootten firebox, more than double the width of an ordinary firebox, and consequently extending right over the trailing wheels on either side. When built, this locomotive was intended to work a fast service of trains on the Philadelphia and Reading Railroad, between Jersey City and Philadelphia, 89·4 miles, in 90 minutes, and it was delivered to that railroad company with the running number 507 on it. In practice, however, it failed to keep time on this schedule, its quickest journey with four cars being 98 minutes, and with five cars 100 minutes, and it was not accepted. Being thrown on the builders' hands, it was subsequently purchased by the Eames Vacuum Brake Co., and was fitted with that speciality. It was then taken to pieces and sent across the Atlantic to England, there to be rebuilt and employed as a sort of commercial traveller for that brake. To enable it to run on British railways, with their smaller "loading gauges"—or clear height and width of bridges, tunnels, stations, and other permanent works—sundry changes had to be made, such as shortening of the chimney, a reduction in the height of the lamp and whistle, and an alteration in the shape of the cab. Even then it was of extreme dimensions, and on arrival an English engine-driver was killed on the engine. He was looking out of the cab at the time, and through a momentary but fatal forgetfulness of the extra width of the engine as compared with those to which he was accustomed, his head came into contact with a signal post. The locomotive, now christened "Lovett Eames," arrived in this country early in 1881, but was not put together until February, 1882, when it

issued from the "shops" of the Lancashire and Yorkshire Railway at Miles Platting in the form shown in the accompanying photograph. On March 15th of the same year it ran its first trip in this country, with a train from Manchester to Leeds and back, and subsequently it made a number of journeys on the Lancashire and Yorkshire and Great Northern Railways. But it was never put to regular work. In July, 1882, it was exhibited at the Alexandra Palace, and at the close of the exhibition it was stabled on the Great Northern Railway at Wood Green. During 1883 it was mostly sheeted down under a tarpaulin, and in 1884, after various fruitless efforts to find a purchaser, it was broken up, all that remains of it to-day being the bell, which hangs over the door of the Great Northern Locomotive Office at King's Cross, still with the name "Lovett Eames" inscribed on it.

Another interval of about fifteen years brings us to another foreign invasion, though this time not on any ordinary main line. The railway up the steep ascent of Snowdon, which was begun early in 1895, is worked on what is known as the Abt system, with rack-rails for the communication of the driving power of the locomotive; and, naturally, the employment of this system, in conjunction with a constantly inclined road-bed, calls for the use of specially designed locomotives. While it is possible that the engine-power could have been supplied by British industry, the engines were, as a matter of fact, ordered from the Swiss Locomotive Works Co., of Winterthur, whose name is particularly associated with engines of this type. As can be seen from the accompanying illustration, even in external appearance these engines are of a distinctly novel character, one noteworthy feature being a general slope of boiler and fittings to counteract the incline on which the engines work. The gauge of the railway is 2 ft. 7½ in., and the engines, which each run on six wheels on the ordinary metals in addition to the cogged wheels which engage in the supplementary rack-rail, weigh, in full working order, with a supply of 440 gallons of water and a half ton of coal, about 16¾ tons. A trial trip on the new line was run on January 8th, 1896, when each single journey up and down the mountain occupied about one hour. Shortly afterwards the line achieved unenviable notoriety, at Eastertide of the same year, by an unfortunate accident, thought to be due to a defect in the road-

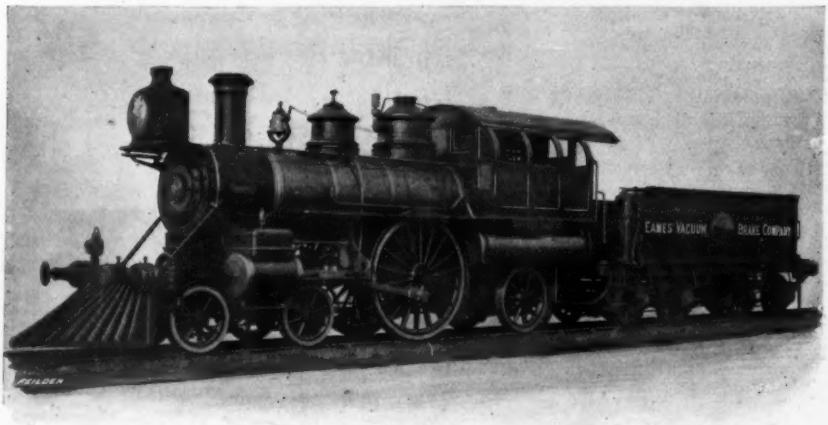


PROTOTYPE OF THE EXPRESS GOODS LOCOMOTIVES BUILT FOR THE GREAT EASTERN RAILWAY, BY MESSRS. SCHNEIDER AND CO., OF CREUSOT, IN 1865.

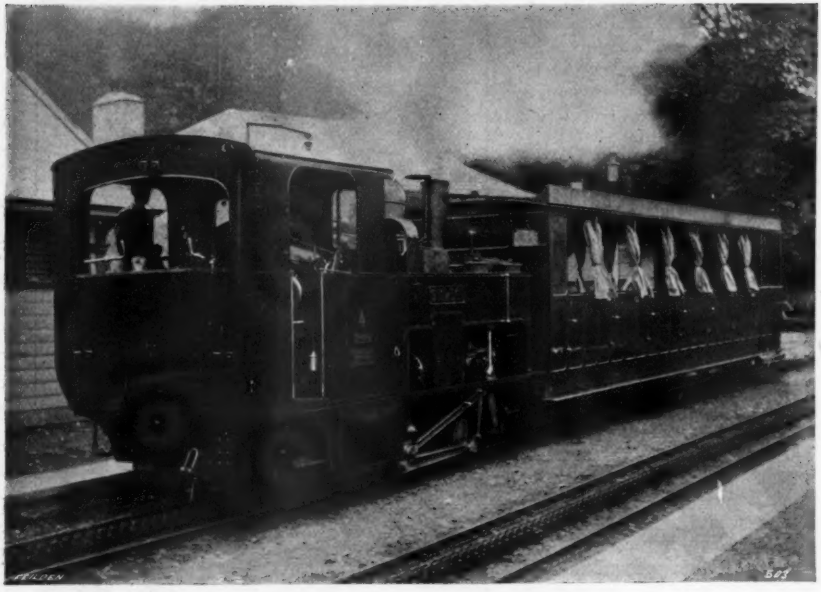
bed. The service was not resumed for a twelvemonth; but since that date there has been no repetition of the initial disaster.

The next importation was also made on account of a narrow-gauge line—the little 1 ft. 11½ in. railway connecting Lynton with the great through route at Barnstaple. A British firm supplied one locomotive for this diminutive line, and another was ordered from the Baldwin Locomotive Works. The American locomotive is a particularly "pretty" little engine, and while built on so reduced a scale for so narrow a gauge it yet is so beautifully proportioned as to present in reality a miniature reproduction of a normal-gauge locomotive. Speaking generally, British engines built for narrow-gauge railways are frequently uncouth and lacking in a sense of due proportion, some parts being incapable of reduction in relation to others. The same rule holds good in this instance, no doubt, but it cannot be disputed that the American scheme of design seems to render this necessary distortion far less apparent, if not quite indistinguishable. The "Lyn," which is here illustrated, is an eight-wheeled engine of what is technically known as the "double-ender" type, and it has four coupled wheels of the small diameter of 2 ft. 9 in., driven by a pair of outside cylinders each measuring 10 in. in diameter with a stroke of 16 in. The weight of the engine, all told, with about a half ton of coal in the bunker and 800 gallons of water in the two side tanks, is just over 20 tons, and it measures, in its extreme dimensions, 26 ft. 10 in. long by 6 ft. 6 in. wide by 9 ft. high. It will be noticed that, in accordance with American practice, a "cowcatcher" is fitted at each end of the locomotive, so as to clear the track of obstructions whichever way the engine may be running. The "Lyn" was put to work about the middle of last year.

We now come to the most serious incursion of "foreign-built" locomotives. It is commonly said that the newly-opened Great Central Railway is mainly responsible for the recent wholesale ordering of engines from America, in consequence of the southward extension of what was formerly the Manchester, Sheffield, and Lincolnshire Railway requiring that many of that Company's engines, hitherto employed in working through goods traffic on "foreign" lines, should be restricted to the newly-christened Company's own metals for the future. However that may be, the fact is sufficiently obtrusive that



THE "LOVETT EAMES" BUILT BY THE BALDWIN LOCOMOTIVE WORKS, PHILADELPHIA, U.S.A., AND SENT ACROSS TO THIS COUNTRY IN 1881 TO ADVERTISE THE EAMES' VACUUM BRAKE.

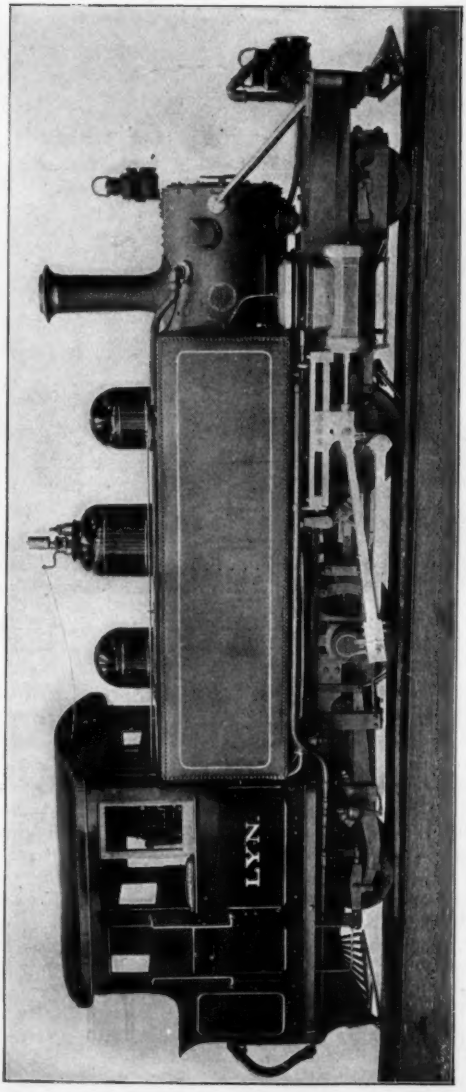


ONE OF THE RACK-RAIL (ABT SYSTEM) LOCOMOTIVES BUILT FOR THE SNOWDON RAILWAY BY THE SWISS LOCOMOTIVE WORKS, OF WINTERTHUR, IN 1895.

the Midland, Great Northern, Great Central, Barry, and other railways, are now engaged in obtaining goods locomotives from American firms of builders. The Midland Railway led off with an original order for ten engines from the Baldwin Company, and ten from the Schenectady Company. The order to the former was subsequently increased to thirty. Following this example, the Great Northern Railway placed an order for twenty engines with the Baldwin Company, and, almost immediately afterwards, the Great Central Railway followed suit with a similar number. Then the Barry Railway Co. divided an order between the Cooke Locomotive Works, of Paterson, N.J., and a Liège firm; and at the moment of writing there are rumours of still further orders going across the Atlantic. Altogether, not far short of 100 locomotives have been put in hand by American firms for British railways during the last few months.

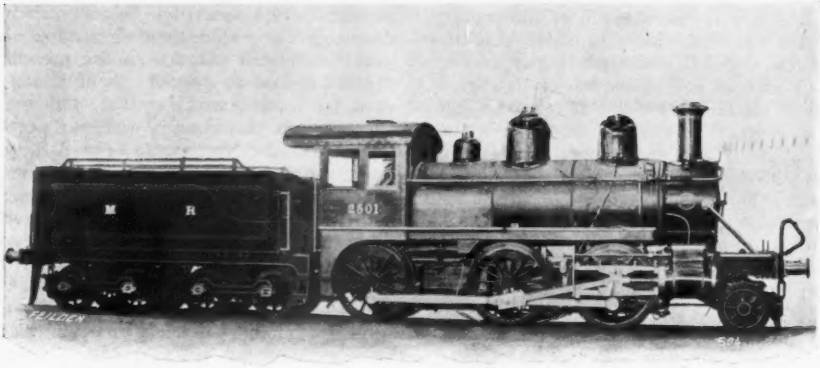
According to the statement made by the Chairman of the Midland Railway Company earlier in the year, the reason for giving orders away from this country was a question of time only, not of cost or any other factor, and at the risk of repeating well-known arguments, Sir Ernest Paget's words may be quoted here. Speaking on February 17th last, he said: "We have at present 170 engines ordered in England. The orders commenced in December, 1897. The first engines were to be delivered in July, 1898, at so many per month, and if that delivery had gone on properly we should now have 48 of those engines. We have not received one. The last order we gave, in December. 1898, was for 20 engines at a very large cost, and we could not get even the promise of one engine for 15 months, and that order will not be completed until May, 1900. Now, gentlemen, engines are a necessity to us: we must have them. Therefore, we determined to send for

tenders from two firms in America, one the Baldwin and the other the Schenectady Works, and we received offers from them. In one instance the delivery was to be in ten weeks from the time that they received all the drawings and other data, and in the other case shipment from America in four months—ten engines from each—so that, you see, while we cannot get an engine promised in England in fifteen months, we can get twenty engines from America in four. I do not think we require further justification, and, thinking so, we have doubled the order to one of those firms." The order has since been still further increased, as already noted, and other lines have followed suit. At the same time, now that these engines to supply the present urgent necessity are in course of delivery, it is very satisfactory to note that the Midland Company has given a new and substantial order to home manufacturers for future supplies.



NARROW-GAUGE LOCOMOTIVE SUPPLIED BY THE BALDWIN LOCOMOTIVE WORKS FOR THE LYNTON AND BARNSTAPLE RAILWAY.

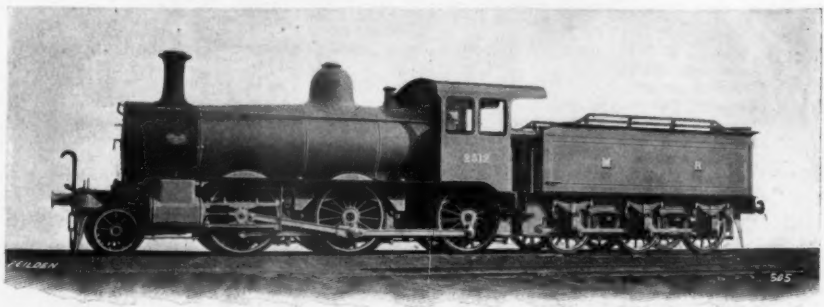
Of these various orders, the earliest has already been fully executed, the Midland Railway Company having received delivery of a batch of ten locomotives from the Baldwin Locomotive Works. This vast establishment, it may be mentioned in passing, turned out an average of two-and-a-half engines per working day during 1898, and according to present indications this output bids fair to be completely out-done in the course of the present year. As can be seen from the accompanying illustration, which has been supplied by the courtesy of the builders, these engines have no great affinity with the "Standard" goods engines on the Midland Railway. They are, in fact, typical Baldwin locomotives of the firm's "standard" pattern, the only modifications being that they are somewhat smaller throughout than a representative American goods engine of the same type, and one or two slight



"MOGUL" FREIGHT LOCOMOTIVE BUILT FOR THE MIDLAND RAILWAY COMPANY BY THE BALDWIN LOCOMOTIVE WORKS, OF PHILADELPHIA, U.S.A., IN 1899.

changes in the materials or methods of construction, effected in deference to British ideas. As regards size, all our readers may not be aware that American engines are not infrequently 15 ft. high to the top of the chimney, and 10 ft. wide, while over here the extreme dimensions are limited to a maximum of 13 ft. 6 in. and about 8 ft. 6 in. respectively, and in addition the nature of platforms and other structures impose other limitations which do not similarly fetter Transatlantic designers.

In general appearance, neither the Baldwin nor the Schenectady locomotives bear much resemblance to the standard Midland goods engine, being both of the "Mogul" type, with outside cylinders, six-coupled driving wheels, and a leading two-wheeled truck, or eight wheels in all. This is a class of engine which has hitherto been a stranger to British metals, if we except a batch of fifteen locomotives built for the Great Eastern Railway Co. by Messrs. Neilson & Co., about twenty years ago—all of which are now broken up. The Baldwin engines are, in fact, American throughout, save only for some few details, specially stipulated for, in deference to British practice. For example, the inside fire-box and the boiler tubes are of copper, instead of being made



"MOGUL" FREIGHT LOCOMOTIVE BUILT FOR THE MIDLAND RAILWAY COMPANY BY THE SCHENECTADY LOCOMOTIVE WORKS, OF SCHENECTADY, N.Y., U.S.A., IN 1899.

of steel, as is customary over the water; and it was furthermore provided that the wheels, injectors, steam-sanding apparatus, water-gauges, and smoke-box doors should be of standard Midland design, and that the engines should be fitted with the combined steam and vacuum brake used on that railway. Otherwise, the builders had a free hand, and employed all the features peculiar to American practice, including the spacious cab and raised running-board alongside the boiler, the bar-frame and outside cylinders, with slide-valves on top, and actuated by means of rocking shafts, and the eight-wheeled double-bogie tender. It should be noted that what appears to be the foremost of two steam domes is in reality the sand-box.

The Schenectady engines, of which the accompanying illustration—provided through the courtesy of the builders—will give an excellent idea, follow much more closely the external appearance of the ordinary Midland stock, and might almost pass for Mr. S. W. Johnson's own design for a "Mogul" engine. The chimney, steam-dome, and safety-valve casing, the sand-boxes, and the six-wheeled tender, are practically copies of Midland practice, and it is only by a closer inspection that the American features are discovered. But, in reality, these engines are in general design quite as Transatlantic as the Baldwin locomotives.

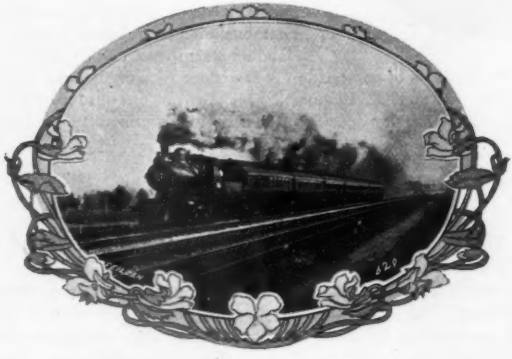
It is noteworthy that in neither case, however, can these foreign importations be said to represent fully the country of their origin, any more than their adopted land. American practice of the present day has arrived at a generosity of dimensions far beyond anything that could be attempted in this country with our puny loading-gauge. Nor, may it be said, have we any use for the huge freight-engines which on the other side of the Atlantic haul trains of cars weighing, loaded, anything from 2,000 tons upwards. To employ one of these monsters on British goods traffic would be well-nigh equivalent to harnessing a shire horse to a suburban butcher's delivery-cart. So that current American practice had, in this instance, to be reduced to a miniature; a fact which should be considered in making any future comparison of the working of the "Moguls" with the standard Midland engines they are intended to rival. In the one case we have a type which, in the course of years, has been perfected until it is very closely adapted to the duty it is set to perform. In the other case we have first-class and widely-experienced firms designing locomotives considerably different from the practice to which they are accustomed, their only guide being certain details as to the gross weight and dimensions permissible, and the average duty to be performed. In this connection it will, doubtless, be interesting to place side by side, in parallel columns, the leading dimensions of a Midland standard "Express Goods," and the Baldwin and Schenectady engines respectively.

	Standard.	Baldwin.	Schenectady.
Diameter of cylinders	18 in.	18 in.	18 in.
Stroke of pistons	26 in.	24 in.	24 in.
Diameter of driving wheels ...	62½ in.	60 in.	60 in.
Diameter of boiler barrel ...	50 in.	56 in.	54⅛ in.
Pressure of steam	150 lbs.	180 lbs.	160 lbs.
Number of tubes	244	263	244
Length of tubes	—	10 ft. 5¾ in.	11 ft. 0 in.
Diameter of tubes	1⅝ in.	1¾ in.	1⅝ in.
Heating surface, firebox ...	110·0	125·3	126·46
,, ,, tubes	1141·0	1247·1	1128·87
,, ,, total	1251·0	1372·4	1255·33
Grate area	17·8	16·6	15·87
	Tons.	Cwts.	Qrs.
Weight, working order	38 15 2	44 15 0	47 15 1
,, adhesive	38 15 2	37 2 0	39 14 2
,, of tender	37 0 0	35 8 0	39 0 0
Capacity, in gallons	3250	3900	3250
,, for coal, tons	5	—	6

At the moment of writing, the Midland Railway has received delivery of the Schenectady engines and of the first batch of the Baldwins, and the Great Northern Railway has also received the engines ordered from the latter firm. The other orders will no doubt follow in due course, and with equal punctuality, and to that extent the various railway companies concerned are sufficiently justified in their unusual and much-criticised giving of substantial orders away from this country. To enter into the question as to why it should have been necessary to go abroad at all in this wholesale fashion would be to open up a matter which cannot be dealt with in this article.

The illustrations of the two Great Eastern engines, the "Lovett Eames" and the "Snowdon," are from photographs published by Mr. F. Moore, of South Place, Finsbury, E.C.

Geo. Fredk. Bird



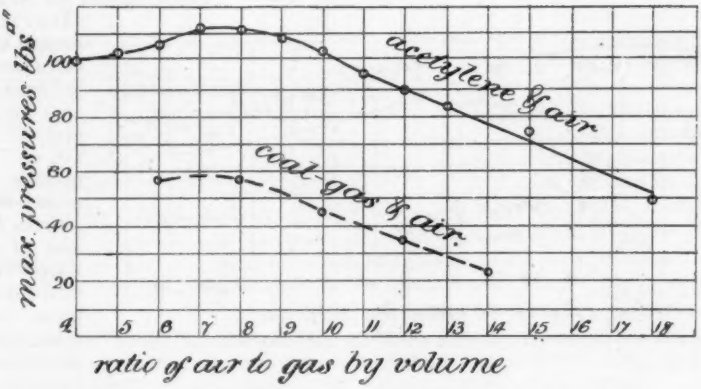
Acetylene for Motive Power.

By FREDERICK GROVER, A.M.I.C.E., M.I.M.E.

MR. FREDERICK GROVER, A.M.I.C.E., M.I.M.E., Consulting Engineer, of Greek Street Chambers, Leeds, was educated at the City of London School, after leaving which he attended the classes at the Crystal Palace School of Engineering, where he headed the lists in mechanical design and in surveying and levelling. He was afterwards admitted to the Engine Works of Messrs. Galloway, of Manchester. Subsequently he was engaged with Messrs. Humphrys Tennant & Co., as assistant in the departments of Mr. A. Langton and Mr. Soper, R.N. He afterwards went to Messrs. W. H. Allen & Co., and from there to Messrs. Thomas Green & Sons, Leeds. In 1893 Mr. Grover was appointed to the Engineering Staff of the Yorkshire College (Victoria University), Leeds. During the last six years he has devoted his energies to the economics of Power Plants, and in this connection has conducted a number of experiments on combustion in smokeless furnaces, on steam boilers, and on steam, gas, and oil engines. His experiments on the influence of the products of combustion in the economics of the gas engine are published in his book on "Modern Gas and Oil Engines." Mr. Grover has also devoted much time to the design of automatic machinery for specific processes in manufacturing industry.

IN May, 1892, Mr. Willson, a Canadian chemist, produced calcium carbide in large quantities, and at a price which permitted the use of this substance for the generation of acetylene gas for industrial processes. Since that time several large works have been erected, and more are being added to their number, for the extended manufacture of calcic carbide. The light-emitting properties of acetylene as compared with the batswing coal-gas flame suggested great possibilities for its use as a domestic illuminant. With a view to developing such possibilities a great number of acetylene generators have been devised which are intended to be safe and automatic in action. While no one will question the brilliance of the acetylene flame, many object to its use in confined spaces because of the impurities which vitiate the atmosphere in which the acetylene burns. In order that this objection may be overcome, either the carbide must be purer than is now usually sold, or the simple generating plants must be supplemented by purifiers, through which the gas must pass before its combustion. The popularity of the gas as a lighting agent may be somewhat checked by these considerations, and it is with a view of stimulating its use in another direction that these notes have been written.

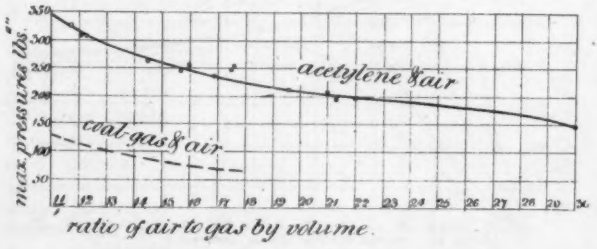
The mechanical details of the internal



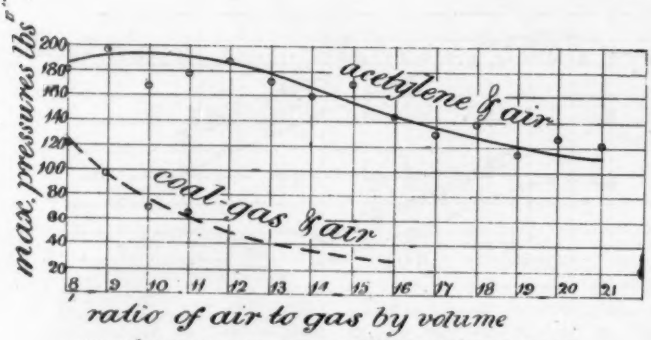
MAXIMUM PRESSURES OBTAINED WITH MIXTURES OF ACETYLENE AND AIR EXPLODED AT 1 ATMOSPHERE.

combustion engine have now crystallised into a standard form, perhaps not yet final, but sufficiently permanent to warrant the assumption that no radical changes are imminent. This being so, the question at once arises: How far is acetylene gas suitable as a working agent in an ordinary gas-engine? So far, those who have led the development of this gas as an illuminant have met with difficulties in two directions. On the one hand, they observe the difficulty of providing burners which do not become choked by carbon deposits: on the other hand, they have evidence of the destructive explosive force of the gas. The application of acetylene to the production of motive power should not be deterred by such experience, for the conditions of combustion are widely different, and in the gas-engine are such as to guarantee the complete combustion of the gas, and the consequent freedom from carbon deposit in the cylinder. The explosive force is determined by the proportion of gas to air in the cylinder, and this has been found to be easily governable. There is every reason to believe that acetylene will be used as a fuel for gas-engines, with what advantages we shall endeavour to point out.

When a pound of calcium carbide (a substance much resembling the appearance of road-metalling) is placed in water a violent ebullition of gas takes place, and a local rise of temperature is observed. The softening crust of the carbide then falls away, giving the water access to the interior of the carbide, which is in turn attacked with the further ebullition of gas. This action continues until the whole crumbles away as a white substance. This is slaked lime, and its presence in the generator is sometimes a source of inefficiency. For it will be apparent that should the carbide become coated with the lime, the free generation of the gas is impeded by insufficient water supply. In some instances the yield of gas



MAXIMUM PRESSURES OBTAINED WITH MIXTURES OF ACETYLENE AND AIR EXPLODED AT 2 ATMOSPHERES.

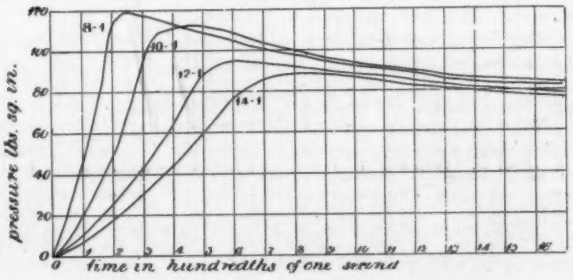


MAXIMUM PRESSURES OBTAINED WITH MIXTURES OF ACETYLENE AND AIR EXPLODED AT 3 ATMOSPHERES.

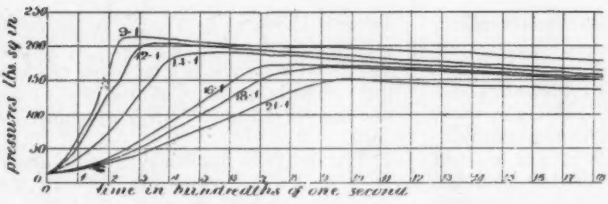
may be as low as $3\frac{1}{2}$ cu. ft. per pound instead of 5 cu. ft. In the former case the carbide is removed with the lime, and is wasted. When the generator is working efficiently, the weight of lime to be removed will be a little more than the original weight of carbide.

Thus it will be seen that the generation of acetylene is a very simple matter. Not only is the weight of carbide compared to the volume of gas a small item, but the safe and convenient form in which it is procurable alike renders it a most suitable substance for self-moving carriages. The form of generator—a question into which we cannot at present enter—is of vital importance, and its choice must depend upon the circumstances under which the generator is to work. When carried upon a motor vehicle, for instance, the carbide must be supported, so that its residue is prevented from shaking into the passages of the generator: on the other hand, the shaking of the vehicle might increase the efficiency of the generation by freeing the carbide from its crust. Such are the points which must be kept well in mind by the designers of generators for use in motor cars.

One is sometimes asked, what are the alterations needed to convert an ordinary gas engine into an acetylene motor. To answer this question we must enquire into the behaviour of acetylene when mixed with various proportions of air, and determine the pressure with such proportions. The author has recently undertaken a series of experiments to ascertain upon a large scale what pressures are developed with various proportions of acetylene; the approximate time from the instant of ignition to that of maximum pressure. These experiments were conducted in a vessel of one cubic foot capacity. Before driving the gas into the cylinder, it was rinsed with pure air, and then a known volume of gas passed over into the explosion cylinder. In many of the experiments the products of combustion were analysed. The mixture was stirred and ignited by an electric spark struck in the centre of the gases. The pressures were recorded on a Crosby indicator, made to inscribe upon a drum revolving at a known speed by clockwork. A constant peripheral speed of the drum was obtained



EXPLOSION DIAGRAM OF ACETYLENE AND AIR FIXED AT 1 ATMOSPHERE INITIAL PRESSURE.



EXPLOSION DIAGRAM OF ACETYLENE AND AIR FIRED AT 2 ATMOSPHERES INITIAL PRESSURE.

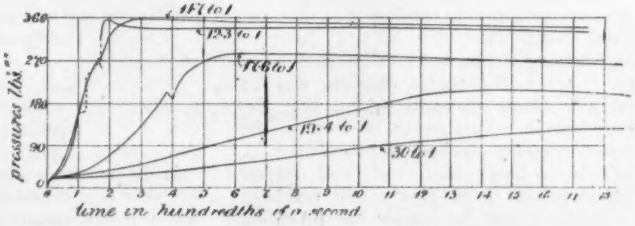
by causing it to rotate a watch in the opposite direction to that of the centre-second hand. A light mirror was attached to the axis of the hand, so that the image of any distant object might be observed. In this way it was found possible to regulate the speed of the recording drum until the image reflected in the mirror became stationary. The optical multiplication thus afforded the observer, compensated for the errors involved in the slow rotation of the watch as compared to that of the drum, to which it was geared by means of a worm and wheel.

Three series of experiments were made with this apparatus. In the first series, known volumes of acetylene were displaced into the cylinder and allowed to diffuse for ten minutes. This operation was assisted by rotating a wing keyed to a spindle passing through a stuffing-box in the cylinder walls. In this series the pressure before ignition was atmospheric; but in the second and third series the pressure before ignition was raised by means of an air pump to 15 and 30 pounds per square inch above that of the atmosphere.

The former publication of disastrous explosions with acetylene gas engendered some feelings of trepidation, and the author deemed it advisable to commence his experiments with very weak mixtures. So weak indeed were the mixtures first attempted, that no ignition took place when the electric arc was struck within the mixture. The proportion of acetylene was then gradually increased, until it existed in the ratio of 1 of acetylene to 18 of air. This mixture fired, and developed a pressure of 50 lbs. per square inch above the atmosphere. Weaker mixtures were attempted several times, but with no success.

The inferior limit of explosibility of a mixture at atmospheric pressure is of importance as affecting the public danger in cases of leakage. In this connection it may be repeated that coal gas at atmospheric pressure is explosive in the proportion of 14 to 1 of gas. It has been said that mixtures of 24 to 1 of gas have been ignited, but in such alleged instances it is highly probable that owing to slow diffusion in the region of the igniter the mixture has been very much stronger than was supposed. Comparing the figures, it is obvious that the leakage of small quantities of acetylene from a generator placed in an ill-ventilated cellar would more readily lead to the formation of an explosive mixture than would be the case with coal gas.

The question of diffusion also bears upon the use of acetylene in combustion engines. It is very generally believed that the diffusibility of a gas is measured directly as the square root of its density, and that coal gas, following this law, and being composed of about 50 per cent.



EXPLOSION DIAGRAM OF ACETYLENE AND AIR EXPLODED AT 3 ATMOSPHERES INITIAL PRESSURE.

hydrogen, will diffuse much more rapidly than acetylene. The rapid diffusion of coal gas is somewhat discredited by the following experiment. A cylinder of about one cubic foot capacity and about three feet long was placed in a vertical position, and a measured volume of gas injected slowly at the bottom of the cylinder. Samples of gas were collected alternately from the bottom and top covers, and analysed for oxygen. It was found that the coal gas ascended and lodged beneath the top cover, displacing therefrom all the air, without any diffusion whatever. From several analyses made at regular intervals of times, it was determined that the diffusion was complete in about one and a-half hours—a lapse of time very different to that usually supposed. Experiences with an ordinary gas engine, in which the ignition tube was placed about half-way down the cylinder, rather confirm this. It is frequently found that when a pump, self-started, is put in action, that the first attempts fail to ignite the charge. Surely this is due to the gas rising as illustrated in the experiment alluded to, and lodging at the upper region of the cylinder. With respect to the comparative diffusibility of acetylene and coal gas, it has been the experience of the writer, after making hundreds of explosion experiments on ordinary coal gas, that there is, if any difference at all, a greater difficulty in bringing about the diffusion of coal gas than there is of acetylene. The alleged difficulty of getting acetylene to diffuse, may have deterred many from making experiments in their gas engines with this gas, but in the opinion of the writer this difficulty is quite without foundation.

Passing on to experiments made at more than one atmosphere initial pressure, it has been found that the inferior limit of explosibility is reached at a mixture of 21 to 1, when the initial pressure was 15 pounds above atmosphere, but that the limit was increased to 30 to 1 when the initial pressure reached 30 pounds per sq. in. It is likely that, with still higher initial pressure, the limit might reach 37 to 40 to 1, but the author has no direct evidence that this would be so.

The mixture recommended by the writer is about 27 to 1. So far as these experiments have gone, there is ample proof that acetylene is a far more efficient gas for the purposes of motive power than any gas yet introduced upon a commercial scale.

The diagrams published herewith afford at a glance a comparison between the pressures developed with mixtures of acetylene and air and mixtures of coal gas and air. The advantages which appear most strikingly in favour of acetylene are, 1st, that the pressures are from twice to three times as great as with the same mixture of coal gas; 2nd, that very weak mixtures of acetylene and air give higher pressures than strong mixtures of coal gas; 3rd, that the time of inflammation is very much less than with coal gas.

With regard to the first point mentioned, it has been urged that the great pressure likely to be set up by a strong charge being drawn into a motor cylinder, is a dangerous factor. No doubt, if this be not guarded against, the motor might suffer. In order to prevent such action, the gas inlet pipe should be limited in bore, or, preferably, the volume of gas supplied to the engine per stroke should be limited by an arrangement capable of letting through only a maximum measured volume of gas to the cylinder. It is to be feared that the ordinary governing arrangements as applied to a gas engine would not have sufficient control of the gas supply. It is well known that a heavy charge frequently follows a series of cut-outs in a gas engine, and if such were to take place with acetylene as the working agent the results might be very disastrous.

The writer believes that the mechanical difficulties of providing a positive check on the gas are not difficult, and that any acetylene motor should be provided with such.

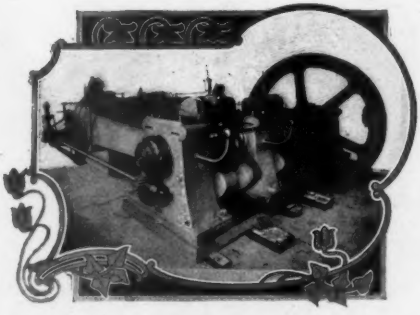
The fact that very small volumes of acetylene are sufficient to form a charge can only be regarded as an offset to the price of the gas. The price of calcic carbide per ton is about £20, and under the very best conditions the cost of working a motor cannot be less than 2½d. per indicated horse power per hour. Hence, although weak mixtures may be used, the

acetylene motor will be regarded as an expensive luxury for some time to come.

The time of inflammation of the gas has an important bearing upon the efficiency of motors. In the motor cylinder there are three distinct periods in the process of combustion which influence the heat efficiency. The first is divided from the second by the instant at which a portion of the charge ignites either by the passage of an electric spark or by the familiar hot tube. The next well-defined period is the time taken for the inflammation to spread through the whole charge; during this time the pressure rises to a maximum; then follows the period of complete combustion, and, lastly, the expansion of the gases. Now, when a motor is run at excessive speed it may happen that the time of inflammation exceeds that of one piston stroke. Such condition must lead to waste, and it is found more economical to limit the speed of the engine. The other extreme—namely, when an engine is run at a very low speed—involves waste, inasmuch as the excessive time allowed per piston stroke permits of the cooling of the gases by long contact with the cylinder walls. It is evident that the faster a motor may be run, provided that due expansion of the gases is possible, the greater will be the heat efficiency of the motor. It is from this point of view that we anticipate in the acetylene motor the most efficient heat engine yet known.

To make an acetylene motor quite self-contained, the ignition tube must be heated by means of an acetylene burner. There is no difficulty in this. The ignition temperature of acetylene is about 900 deg. Fahr., whereas the ignition temperature of hydrogen—the most easily ignited constituent of coal gas—is 1124 deg. Fahr.

Fred C. R. Grover.



Modern Appliances in Gas Manufacture.

By G. E. STEVENSON, M.I.C.E.

PART I.—STOKING MACHINERY.

(*Continued from page 462.*)

The drawing machine consists of a beam carrying two horizontal cylinders, one for driving in the rake and the other for drawing it out, the action being similar to that of the charger; but in the case of the drawer the larger cylinder is required for withdrawing the rake together with the coke. The lever actuating the valve for working the rake is attached to the beam in such a manner that the movement which sets the valve for pushing in the rake at the same time depresses the back end of the beam, allowing the rake to rise and pass over the coke. The reverse movement elevates the back end of the beam, allowing the rake to drop into the coke. Only a portion of the coke is drawn at each entry and withdrawal of the rake, which is made to enter further into the retort at each successive stroke.

The water pressure is communicated to the machine through flexible hose-pipes fixed to travelling carriages running on bars, secured either to the walls of the retort-house or the tie-rods of the roof. A duplicate set of pipes is provided for

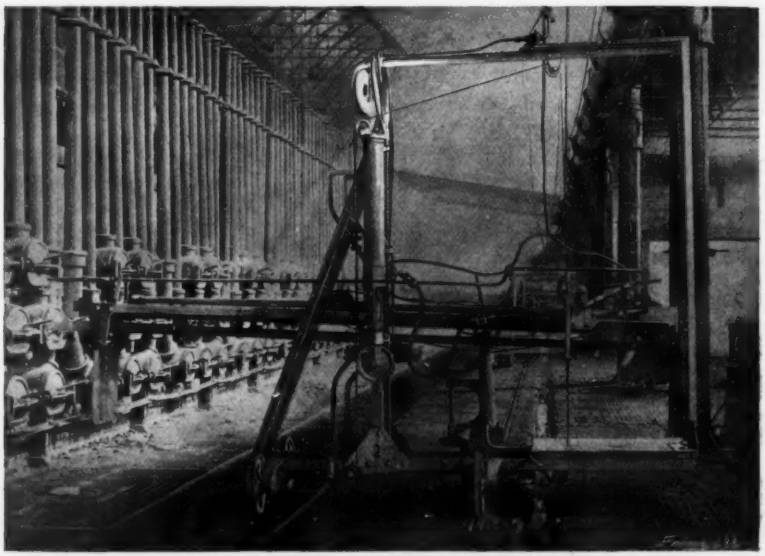


FIG. 11.—FOULIS-ARROL HYDRAULIC DRAWING MACHINE.

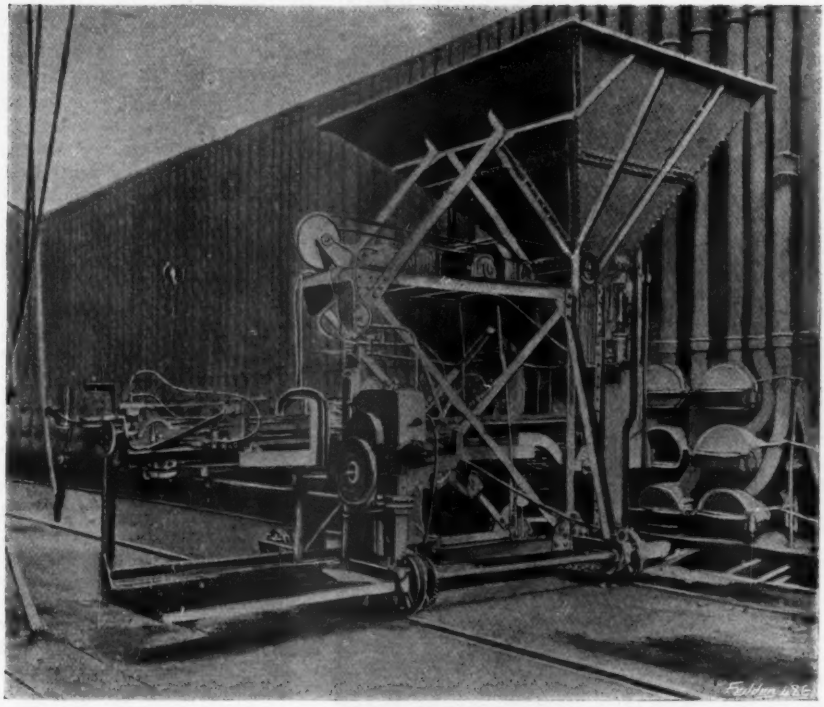


FIG. 12.—FOULIS-ARROL HYDRAULIC CHARGING MACHINE.

the return water from the charging-machines. The connection with the machines is made by swivels, similar to those used for connecting fire-hose.

In Mr. Foulis' new arrangement the coal is stored in large hoppers fixed over the centre of the retort bench, and provided with shoots at either side for filling the hoppers on the charging machines. The coal is previously broken and elevated into the storage hoppers.

An addition to the charging machine has quite recently been made in the shape of an elevator attached to the machine itself, which picks up the coal from a continuous bunker behind the machine, thus dispensing with the necessity of previously elevating the coal into storage hoppers. This arrangement is, however, only applicable for coal that is sufficiently small to require no breaking.

The mechanism of the Foulis-Arrol Stoking machines is of a very superior class and well adapted for its purpose. Rapidity of movement is combined with strength and compactness. This machinery has been introduced into the works of the three Metropolitan Gas Companies. It is in use throughout the gas works of the Glasgow Corporation, also in the Birmingham Gas Works, and in several gas works of less magnitude in other towns.

By the introduction of stoking machinery in gas works the labour expenses entailed in gas manufacture have been much reduced. The work is also made more tolerable for the workmen. Although the men are still exposed to the heat and

smoke inseparable from the operations of gas making, they are relieved of the exhausting work of lifting tons upon tons of coal and throwing it into the retorts and dragging therefrom the coke. Under the old system of drawing and charging by hand, each stoker was expected to handle three tons of coal during his day's work and to remove the resultant coke. He had also to attend to two furnaces. For each bed, or oven, of seven retorts one man per diem of 24 hours was employed, the hours of work being from 6 a.m. to 6 p.m. for the day shift, and from 6 p.m. to 6 a.m. for the night shift, the men on each shift taking charge of two ovens, or 14 retorts each. With the modern stoking machinery one drawing and one charging machine will draw and charge from 900 to 1,000 retorts in the 24 hours; that is to say, they will put in 1,000 charges of 3 to 4 cwts. each and withdraw the coke. This means the manipulation of some 175 tons of coal and 110 tons of coke—together, 285 tons of material. As the hours of labour for gas workers are now usually eight, with three shifts in a day, it follows that six men are employed in directing one pair of machines during 24 hours. These men require six assistants to open and close the retorts. Twelve firemen would be required to attend to the furnaces, and, if no mechanical arrangements are provided for removing the coke, twelve men will be employed to wheel it out of the retort house, slake it, and tip it in the yard. A few extra men will be needed to clean the ascension pipes which convey the gas from the retorts, and do other odd work, and there will be three engine-men wanted, one on each shift, to look after the hydraulic or air-compressing engines, and the elevators and conveyors, etc.

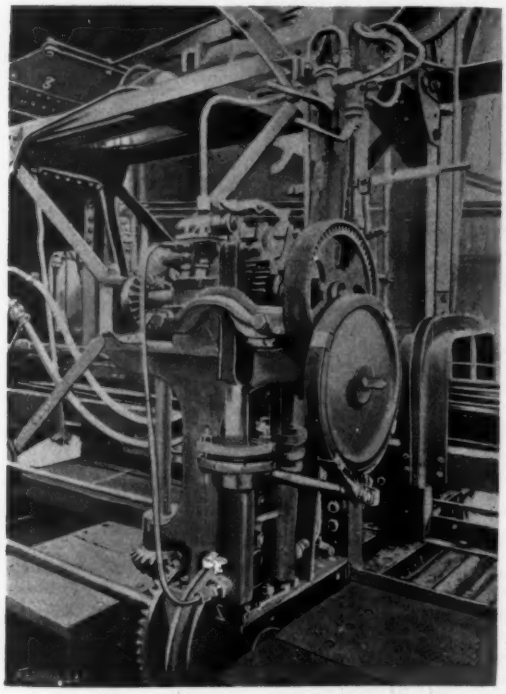


FIG. 13.—HYDRAULIC MOTOR ON FOULIS-ARROL CHARGING MACHINE.

Altogether about forty-five men will be the number employed for the carbonising work which one set of machines can comfortably undertake. The weight of coal will work out to 4 tons per man for eight-hour shifts, or 6 tons per man if twelve-hour shifts are in vogue.

It is generally agreed that the saving in wages effected by the adoption of stoking machinery amounts to a sum equal to *1s. 3d.* per ton of coal carbonised. The work of drawing and charging each retort is accomplished in a shorter space of time than under the old system, and the duty percentage of the retorts is higher both in point of time usefully occupied and in weight of material carbonised.

PART II.—INCLINED RETORTS, &c.

A new method of building retort-settings has, during the past eight years, come into vogue, designated "The Inclined Retort System."

On this system, the retorts are no longer placed horizontally, but are set at an angle varying from 28 to 34 degrees from the horizontal.

The object aimed at in setting retorts at an angle is to enable them to be charged and discharged by gravitation. The coal, instead of being deposited in the retorts by means of a scoop, or pushed into them by mechanical force, is allowed to slide into them from the upper end, and the coke is allowed to slide out at the lower end.

The angle at which the retorts are set is determined in accordance with the known property of solids to assume a position of rest at a certain angle so soon as the impetus due to the momentum acquired by its own weight, after it has once been set in motion, is expended. This angle, called "the angle of repose," differs for different materials, and must be determined by experiment. In the case of coal the angle varies within certain limits, owing to the varying physical constitution of the coal and its behaviour under the process of carbonization. Certain coals of a bituminous character become pasty when undergoing distillation. Coagulating into a tarry mass in the initial stage of carbonization, they are no longer able to retain their position on an inclined plane the angle of which is sufficiently flat to enable them to do so when cold. For such coals an angle of 28 or 29 degrees is most suitable, and the deposition of the coal in the retort must be brought about by giving it a greater impetus than would be necessary were a steeper angle used. Other coals, not changing their condition to the same extent, may be distilled in retorts set at a steeper angle with advantage.

The inclined system of retort setting is the invention of a Frenchman, Monsieur Coze, the gas engineer at Rheims. Since its introduction into England, the method of applying this principle has undergone improvements which have rendered it more practical and more suited to the manufacture of gas on a large scale. At the present day most inclined retorts in this country are set an angle of 31 or 32 degrees. Their length is generally 20 ft., but in some of the smaller installations it is 15 ft. The inclined retorts are heated

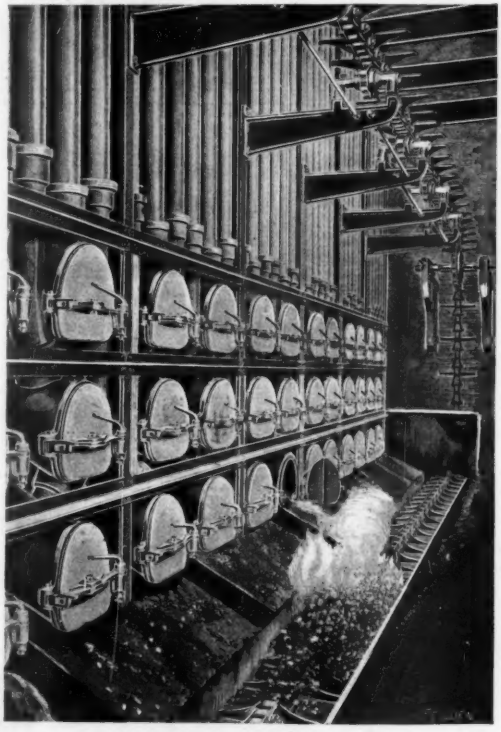


FIG. 14.—INSTALLATION OF INCLINED RETORTS, GAYTHORNE STATION, MANCHESTER GAS CORPORATION WORKS.

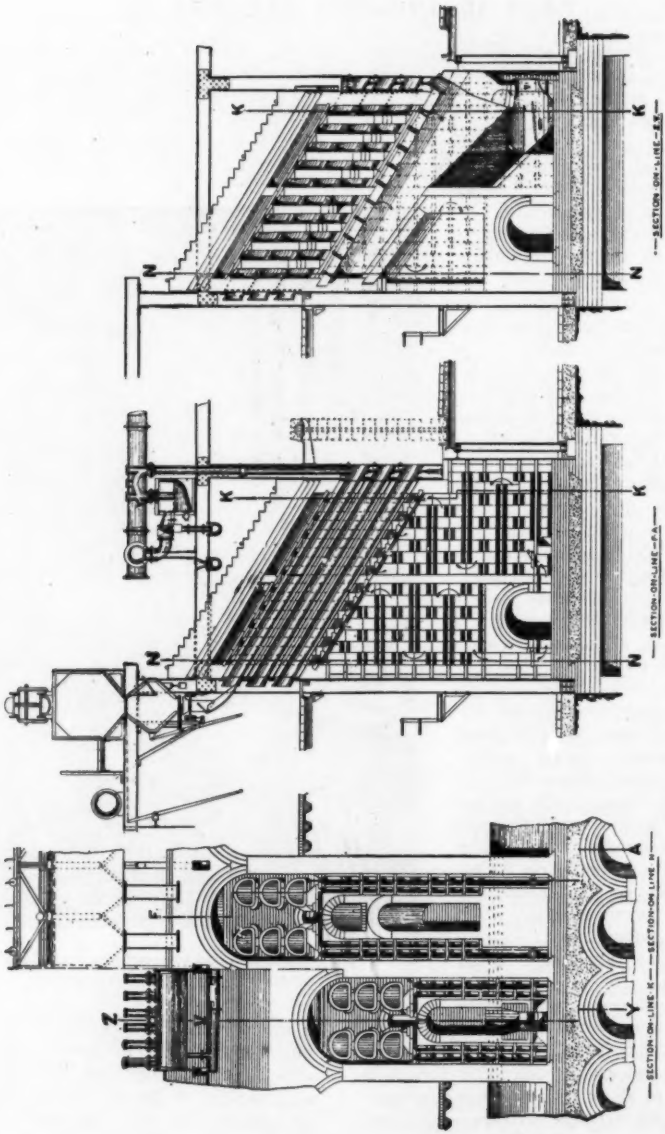


FIG. 15.—SECTIONS OF INCLINED RETORT SETTING AT GAYTHORN STATION, MANCHESTER.

in the same manner as horizontal retorts, by regenerator furnaces, the furnace being fired at the front side, where the lower ends of the retorts are situated, and the heat rising to the higher portion of the retorts at the back.

The inclined retort system involves the raising of the coal to the high level at the back of the retorts and the provision of mechanism for delivering it into the retorts in such a manner that it will pour into the retort in a continuous stream, filling the retort with a uniform layer of coal from the bottom to the top.

Hence the introduction of this system has given rise to an elaborate development of coal-conveying and distributing apparatus. The coal must first be broken into small pieces, because large lumps cannot be picked up by the elevators and carried into the conveyors, nor passed through the slides and shoots used for charging the retorts. Moreover, it is found that if the coal be not of uniform size its velocity when entering the retort cannot be properly regulated, for the

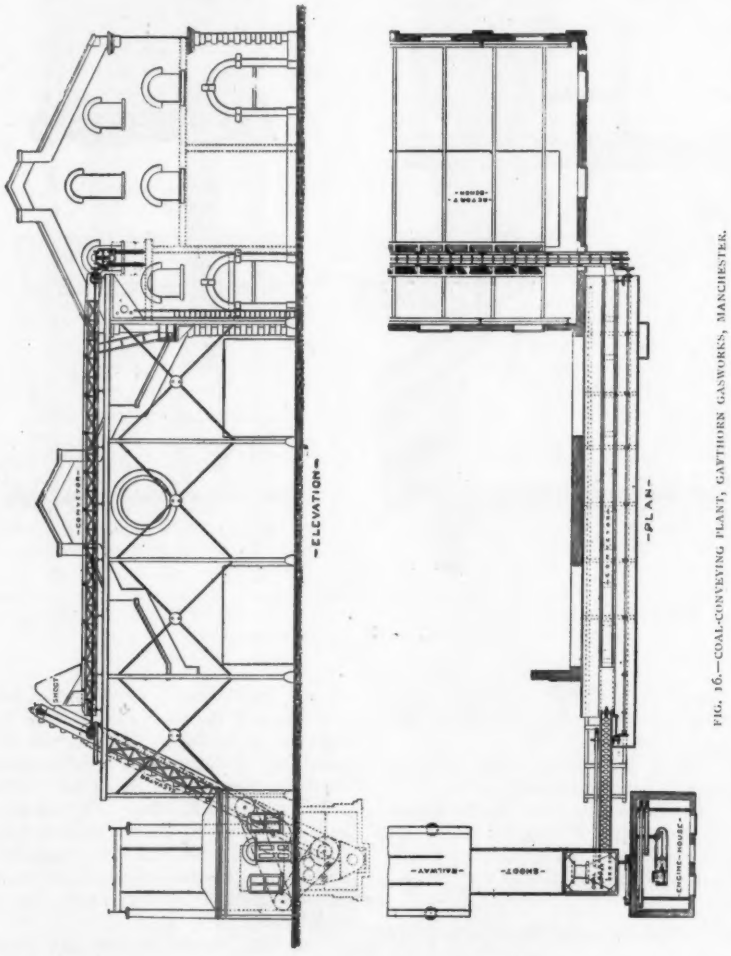


FIG. 16.—COAL-CONVEYING PLANT, GAYTHORN GASWORKS, MANCHESTER.

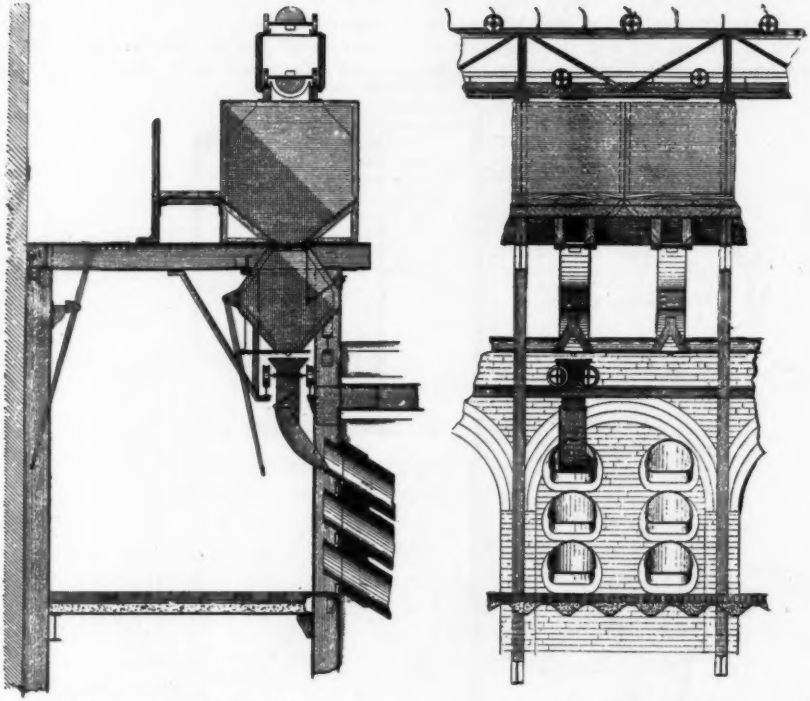


FIG. 17.—SECTIONAL ELEVATION. FIG. 18.—FRONT ELEVATION.

METHOD OF CHARGING MACHINE RETORTS.

large lumps roll down rapidly to the bottom end of the retort whilst the small coal lags behind.

After being broken the coal requires elevating to a height of from 40 to 50 ft. above the discharging floor of the retort house, in order that it may be stored in overhead hoppers, or bunkers, from which supplies may be drawn off for charging the retorts.

THE GAYTHORN INSTALLATION, MANCHESTER.

As an example of the most completely automatic plant for dealing with the coal to be used in inclined retorts, we may take the recent installation at the Gaythorn Station of the Manchester Corporation Gas Works (Figs. 15 and 16).

For the reception of the inclined retorts an old retort house was emptied of its contents and the walls raised from 20 ft. high to 35 ft. high. The retort bench comprises 18 settings of retorts arranged in two sections, there being six retorts in each setting, 20 ft. long. The settings are built up from a basement 10 ft. below the ground level. At the two ends of the retort house are two chimneys, with which the two sections of the main flue communicate.

The coal supply for the gas works is received on sidings at a level of 30 ft. above the ground. Behind an adjoining retort house are coal stores, with lines of rails overhead for dropping the coal into store from the wagons. To one of these lines an extension was made, terminating where the upper end of a shoot com-

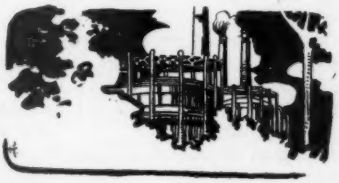
mences. The bottom end of the shoot communicates with a large main hopper, below which is fixed the breaker for breaking up the coal and cannel. The wagons are brought directly over the top of the shoot and the bottom doors opened, allowing the coal to fall on the shoot and descend into the hopper. After the coal has passed through the breaker it is raised by an elevator to a height of 46 ft., and delivered on a cotton "band" conveyor, which is supported on a scaffolding of steel uprights and girders, and situated parallel to the gable end of the retort-house. On this "band" conveyor the coal travels along in a perfectly quiescent state and in a thin stream, till, at the end of it, it falls into the trough of another conveyor of a different type, known as a "push-plate" conveyor.

The push-plate conveyor is fixed at right angles to the band conveyor, and passes over the centre of a continuous rectangular coal bunker built of steel plates and situated above and behind the retort bench. In the trough of the push-plate conveyor are openings at intervals, and as the coal is pushed along by the plates, or blades, of the conveyor it falls through these openings and fills up the bunker, for, when the space under one opening is full, the coal is dragged over the coal already stored to the next opening, and fills in succession the space under each opening until the whole bunker is full. This is what occurs if the coal is allowed to accumulate and is not drawn off for use. At the bottom of the bunker, however, there is a series of conical pockets (Figs. 17 and 18) the pockets being situated immediately over the centre line of each tier of retorts. The openings in the conveyor are over the centre of the pockets, and therefore the pockets are filled first, and continue to receive and contain coal even when the upper part of the bunker is not filled. When the pockets and the bunker are completely full, the quantity of coal stored in them is about 120 tons, or sufficient for 16 hours consumption by the whole range of retorts.

In this manner the coal supply is automatically conveyed into position for charging the retorts, no hand labour being required further than to open the doors of the railway wagons and tumble the coal out of them. When it becomes necessary to use coal that has previously been put into store, the coal is loaded into small tipping trucks, and the trucks are hauled to the main hopper, at the side of which is a supplementary elevator for raising the coal into the hopper. The whole of this machinery is set in motion by a 16-h.p. steam engine situated in an engine-house adjoining the main hopper.

W. E. Stevenson

(To be continued.)



Pneumatic Tools and Appliances.

By EWART C. AMOS, M.I.Mech.E.

PART I.—INTRODUCTORY REMARKS—DRILLS—HAMMERS.

It is very evident that Pneumatic Tools have "come to stay," and at the same time are likely to enter into serious competition with certain classes of belt-driven, hydraulic, and hand-tools. But, notwithstanding the rapid strides which have taken place of late in the adoption of these tools for shop and constructional purposes, it is doubtful whether the many advantages to be derived from their more extended use are at present fully recognised by our engineers. This remark may probably call forth some adverse criticism, but, whether it does so or not, it will be generally admitted that we in this country are at present very much behind in regard to the manufacture of these pneumatic appliances. In making this statement it is borne in mind that air-compressors, pneumatic riveters and large power fixed hammers have been successfully built and used here for some years past, and that at the present time British manufacturers are still engaged on the production of these particular machines, with satisfaction alike to their clients and themselves; but what these articles will demonstrate is that the bulk of the pneumatic appliances, such as drills, hammers, hoists. &c., at present in demand, are constructed under American patents, and are almost entirely imported machines. Competition with the ordinary machine tool is chiefly confined to that class of tool where portability is essential, such as in drilling, rymering, riveting, caulking, or beading work in position, in ship-building, &c., although there is every reason to expect great extension of the application of pneumatic driving to larger machines. We have got, moreover, what is practically an addition to the recognised type of tools, viz., the Pneumatic Hand Hammer. As to the saving effected by the use of chipping hammers, this is immense, and the same remark applies to tools for drilling, caulking, &c.; but a certain objection, in the form of considerable vibration, still exists in many of the hammers, which makes it difficult to get our men to take kindly to them.

It might be well at the outset of these articles to state frankly that the author is not an American, nor is he interested in any way whatever with either an English or American patent or manufacturer of these tools, and his object is to place before the readers of this Magazine a fair and up-to-date representation of some of the appliances now in use, illustrating his remarks and description by means of photos and diagrams. It must be added, however, that so rapid is the advance being made in the improvements effected that it is exceedingly difficult to secure a representation of the very latest thing, as the makers themselves admit that they are at present constantly changing their design, and are likely to do so for some little time to come. It may be said at once that the subject is a big one and covers much ground, and whilst it is desirable to give a fair amount of technical description it is not intended that this shall become tedious, neither is it possible in the space available to minutely describe every type of machine. In order to conveniently treat with the subject under consideration, it is proposed to divide it under the following heads:—

(1) Advantages of compressed air as a motive power.
(2) Pneumatic hammers and kindred appliances.
(3) Pneumatic drills.
(4) Air compressors.

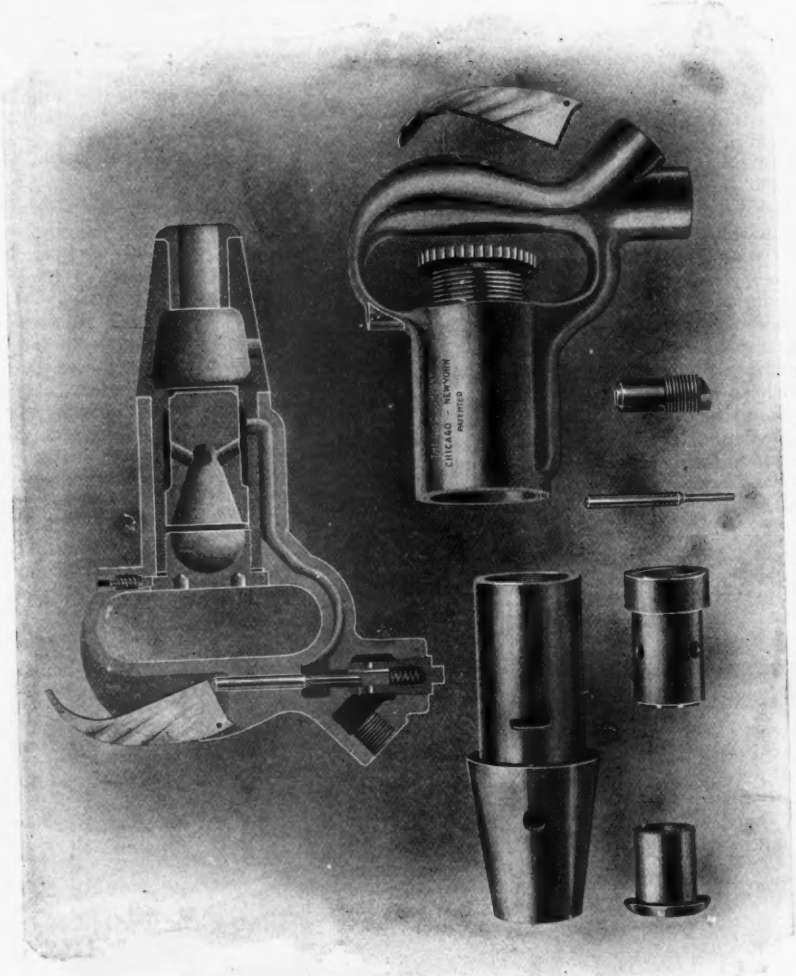


FIG. 1.—THE "Q AND C" SINGLE HAMMER

(5) Pneumatic riveters.
(6) Miscellaneous machines—with a consideration of the cost of the system.

ADVANTAGES OF COMPRESSED AIR AS A MOTIVE FORCE.

Under this heading we have to consider the advantages of compressed air acting direct on the tool through suitable mechanism as compared with steam and water motors applied direct or with the intervention of belting, &c., and also with electric motors. In this country we are much in favour of steam and hydraulic motors, and especially the latter, for the purposes of riveting; but even for this it must be admitted compressed air possesses advantages, under certain conditions, that neither steam nor water can lay claim to, inasmuch as the work is not only equal, and in many cases better, than with the steam or hydraulic power, but the pneumatic riveter is both cheaper to work and easier to handle, being so much lighter, and, moreover, dispensing with the necessity of expensive and cumbersome accumulators, expensive piping, &c. When dealing with the riveter section, further reference will be made to this point.

Probably the greatest claim that can be made in favour of compressed air is the great portability permissible in the tools to which it can be applied. So much is this the case as regards shipbuilding and constructional engineering work generally, that it has practically caused a revolution, and, moreover, the use of some such contrivance had become a necessity, owing to the substitution of steel for iron, and especially cast steel in place of forgings, which is now almost universal. This greatly increased the cost of labour in fitting, caulking and drilling, but the introduction of air-driven tools has made it possible to machine the harder material more economically than the softer metal could be worked by hand, and notwithstanding the added cost of plant. In connection with this, it might be well to quote an American Professor's remark at an

FIG. 2.—THE "ROSS" CAULKING AND CHIPPING HAMMER.

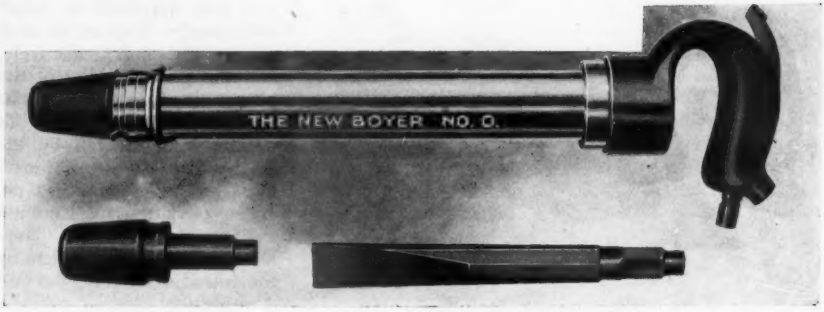


FIG. 3.—THE "BOYER" CHIPPING HAMMER; ALSO SUITABLE FOR HAND RIVETING.

Engineering Congress held at Chicago in 1893.

"Among the various mechanical aids which would be of distinct value to the shipbuilder, few would stand higher or be more acceptable than one which would efficiently replace the ship-riveter's gang."

Since then this desirable condition of things has been achieved by the pneumatic tool, and with a result in every way satisfactory. Again, the absence of heat in any part of the appliance enables the operator to continuously handle it, and with every sense of freedom from danger such as might arise from escape of steam or short circuiting from high voltage currents. When comparing it with electric-driven machines, however, the advantages are not so apparent, but still they do exist in a number of points; but as there is every probability of great improvements being effected in electric driving, it is too early to say at present how the competition will end. These machines have also made it possible to operate on work in position, which work, for economical reasons, had before to be machined or drilled in the shop previous to erection: the result is far more satisfactory and would always have been resorted to excepting for the fact of the great cost due to the necessary hand labour previous to the introduction of pneumatic tools. This is a point not perhaps fully appreciated until these tools are actually adopted. Enough has been said to briefly indicate the advantages of compressed air for the purposes specified, and whilst, as has already been pointed out, its application is at present largely confined to driving small portable motors, there is reason to suppose that larger and more powerful machines may be driven by it.

PNEUMATIC HAMMERS.

Coming now to a consideration of the tools themselves, the class first to be described is the hammer. This, in various forms, may be used for chipping, caulking, beading, fettling, scaling, riveting, stone dressing and carving, and driving plug holes in stone, &c. There are a number of types upon the market, all represented to be the best, and all more or less suffering from some amount of recoil. To obviate this objection, whilst at the same time maintaining the effectiveness of the tool, is what is sought for by the makers. This

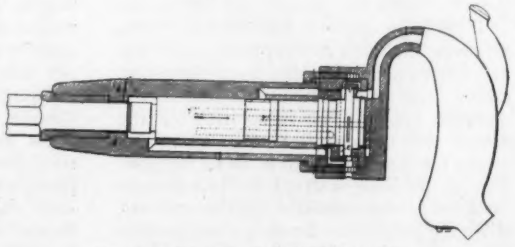


FIG. 4.—SECTIONAL VIEW "BOYER" HAMMER.

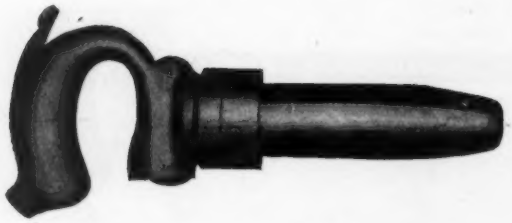


FIG. 5.—ORIGINAL PATTERN "LITTLE GIANT" HAMMER.

is attempted by various means, and the photos and diagrams, which show both external and sectional views, illustrate the methods adopted: whilst these will be described together with the claims put forward on behalf of each tool, it would obviously not be fair to endorse those of any particular type in preference to any other, but rather is it advantageous to let each type speak for itself.

Fig. 1 shows, in section, a "*Q* and *C*" single hammer which is of exceedingly simple construction, the several parts of which it consists being also shown, and it will perhaps serve as well as any to illustrate the action of a hammer. Referring to the block, it will be seen that the parts consist of (1) the striking piston which acts as its own valve; (2) the hardened tool-steel case or cylinder in which it works; (3) the bronze handle; (4) the nut or cap to hold the handle in the case or cylinder; (5) the throttle valve and trigger, also made of tool steel hardened and ground. Its action is as follows:—Air being admitted by a broad passage between the case and the handle, and thence through a large air port into the pressure chamber, maintains a constant pressure under the shoulder of the piston and tends to drive it backwards; when, however, the ports in the piston, which are also large openings, come into communication with the pressure chamber, the pressure fills the hollow portion of the piston and the cylinder in its rear; this forces the piston forward to strike its blow. Just as the blow is struck the piston ports come into communication with the exhaust, when the pressure under the piston shoulder again returns the piston, and the blows are thus repeated in rapid succession. The air is used expansively and effectively, and the great rapidity of the blows given reduces the jar or recoil to a minimum, but it was evidently felt by the makers that some improvement was possible in this type, and to obviate what is termed a "minimum recoil" they have modified the design by the introduction of a second piston placed within the case or cylinder working in the opposite direction to the main or striking piston. By this means, the shock or vibration is more efficiently absorbed, and the operator is thereby considerably relieved.

These tools are made in a variety of sizes, and, as an indication of their capacity and air consumption, it may be stated that the lightest size of the double-piston or counterbalance type weighs 10 lbs., consumes 12 cubic feet of free air per minute, and is suitable for medium chipping, caulking, and beading, whilst the heaviest pattern, which is suitable for heavy chipping, and driving hot rivets up to $\frac{5}{8}$ in., weighs 20 lbs. and consumes 20 cubic feet of free air per minute.

The single-piston type, as shown in the illustration, is lighter throughout, a hammer using 12 cubic feet of free air per minute weighing only 8 lbs.

Fig. 2 represents a section and outside view of the "Ross" hammer, which is of British construction, and of which considerable numbers are stated to be in use and giving every satisfaction; the section is from a hammer with a cast body and with the exhaust valve actuated by a trigger which, when held back by the finger, allows the tool to work with such rapidity as to give 8,000 to 10,000 strokes per minute when working with an air pressure of 60 lbs. per square inch. The outside view of this hammer shows the latest form, having the body made from solid-drawn steel tube and a handle of phosphor bronze screwed on. In this case, the air is admitted through the handle from below and the exhaust from top side of handle. The small distance

piece between the piston end and the chisel is now dispensed with, the working piston striking directly on the chisel end. In this hammer also there are no valves beyond those for starting and stopping, and when working, the piston itself regulates the distribution of the air pressure to secure reciprocation of the moving parts.

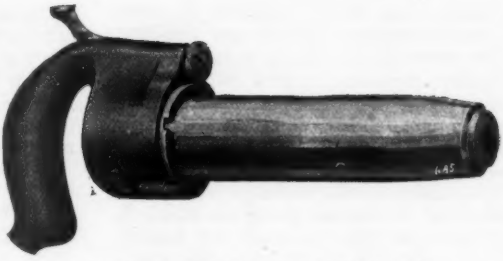


FIG. 5A.—LATEST PATTERN "LITTLE GIANT" HAMMER.

Figs. 3 and 4 are representations, in elevation and section, of the new "Boyer" hammer. The principle of this hammer is distinctly different from the two already described, inasmuch as it does not make use of the striking piston to entirely regulate the distribution of air, but employs a hollow valve of cylindrical shape placed at the rear or handle end of the hammer.

In ordinary chipping and caulking hammers, it is desirable that the length of the body should be as short as possible—in other words, that the handle should not be an undue distance from the bit; at the same time, the length of stroke necessary to give an efficient blow has to be maintained, and where a valve is used, as in the case of a Boyer hammer, it is found convenient to place it in the rear. In the early hammers of this type the valve gear was fitted immediately behind the piston chamber, which had the effect of reducing the length of the hammer as an available working space for the piston; in its present type, however, the valve is so arranged that the piston can pass through it, thus reducing the length of the hammer. With regard to the question of the length of the hammer, this of course varies with the class of work to be done and the consequent length of stroke, and Fig. 3 illustrates a type of Boyer hammer having a specially long stroke, striking a considerable blow, and also suited for the purposes of hand riveting. For ordinary work the Boyer hammer is as short as any. It is not possible to minutely explain the construction of this hammer, which, although simple and efficient in action, is a somewhat complicated piece of mechanism, since it would involve a number of diagrams to do justice to it, besides requiring a lengthy description, but its principle may be briefly explained by reference to the sectional view, Fig. 4. As in the other hammers, the body forms a cylinder within which is a reciprocating piston which strikes the blow. The piston receives its motion from the admission of air under pressure to either side of it alternately, the air admission being controlled by a cylindrical valve, itself having a reciprocating motion produced by the air pressure acting alternately on differential areas and through suitable exhaust ports, and in this manner the hammer is caused to give a continuous number of reciprocations and blows. The valve itself is an exceedingly ingenious and beautifully-constructed piece of mechanism, as in a moderate-sized hammer it only weighs about 1 oz., with a stroke of something like $\frac{1}{8}$ in. whilst its substance is in places as thin as $\frac{1}{64}$ in. Notwithstanding this, however, the hammers will stand regular work, and without any special handling, and there is no difficulty in getting any ordinary mechanic to use them after very little experience, and without danger of injuring the hammer, since all the mechanism is carefully enclosed. Boyer hammers are made in various sizes and weights, ranging from $8\frac{1}{4}$ lbs. to $12\frac{1}{4}$ lbs., the average size in most general use weighing about 9 lbs., whilst their air capacity may be taken to vary from 10 to 15 cubic feet of free air per minute.

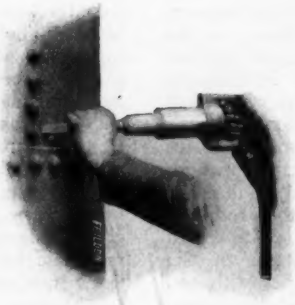
Figs. 5 and 5A represent the "Little Giant" hammer; Fig. 5 shows the original type, whilst Fig. 5A shows the latest pattern, which is provided with an air

regulator that can be adjusted to admit a minimum amount of air and deliver a blow with full force of the hammer under various pressures. This is likely to secure ease in operation, whilst on the return stroke a cushion is formed on the exhaust air, which is claimed to effect a saving of 30 per cent. of air as compared with hammers that cushion on live air admitted before the piston completes its stroke. In this hammer also the air admission to the piston is regulated by an automatic valve placed in the rear end of the hammer, but different in construction to that of the one already described. A hammer of this type weighing 8 lbs. consumes 10 cubic feet of free air per minute.

Like most hammers, the "Little Giant" is also suited for beading, riveting, &c., and, it is claimed, will do the work of four men chipping by hand.

(To be continued.)

Ewart S. Amos



Acetylene Generators.

By Professor VIVIAN B. LEWES.

(Part V.—*continued from p. 453.*)

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It was Dickerson in America who first made a generator in which carbide was fed into an excess of water, and took out a patent for it in December, 1894. He used pulverised or granulated carbide contained in a hopper at the bottom of which was a valve automatically controlled by the rise or fall of the holder,

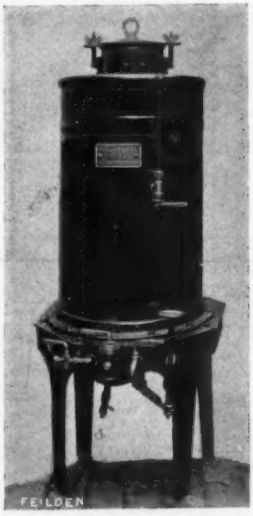

Fig. 41.—The "Acetylite" Generator.

and which allowed the carbide as required to fall into the water in the generator beneath, the water in which was kept at a constant level.

Later on, Pictet made a generator in which carbide was thrown by hand into water which was kept at a low temperature by a coil of pipe through which ice-cold water could be made to flow. From the first it was recognised by scientific men that adding carbide to water was the right way to generate the gas; but it had one drawback: the generator inventors were bitten with a craze for making automatic generators and doing away with a store holder that should contain enough gas for the evening's consumption. It was fairly easy to do this if one had to regulate the dripping of a liquid like water, but very difficult when a solid like calcium carbide had to be dealt with, and the result was that the first big class of generators in which the water was brought to the carbide was devised wholesale, whilst the carbide into water class was neglected. It was not long, however, before the demand for generators of this latter class led to attempts being made to overcome the problem, and although a thoroughly satisfactory solution has hardly yet been arrived at, still there are several fairly satisfactory automatic generators in which the carbide is fed into water. The means adopted for feeding the carbide automatically into water are: (1) By allowing granulated carbide to be fed by gravity from a hopper closed at the bottom by valves of various construction worked by the rise or fall of the holder. (2) Drawing carbide from a store holder and dropping it into water by the revolution of a worm or screw. (3) Unlatching the bottom of holders containing carbide, so as to discharge the contents into water, or making a series of bottomless holders, filled with carbide, slide on a metal plate over a hole through which the carbide falls into the water. (4) Automatically dropping vessels containing carbide into water in a generator, this latter type hardly belonging to this class of generator, as the infiltration of water to the carbide vessel really makes it a water to carbide machine.

The "Acetylite" generator (Figs. 41 and 42) consists of a tank with double walls, *A A*, between which the holder bell *B* is free to move up and down.

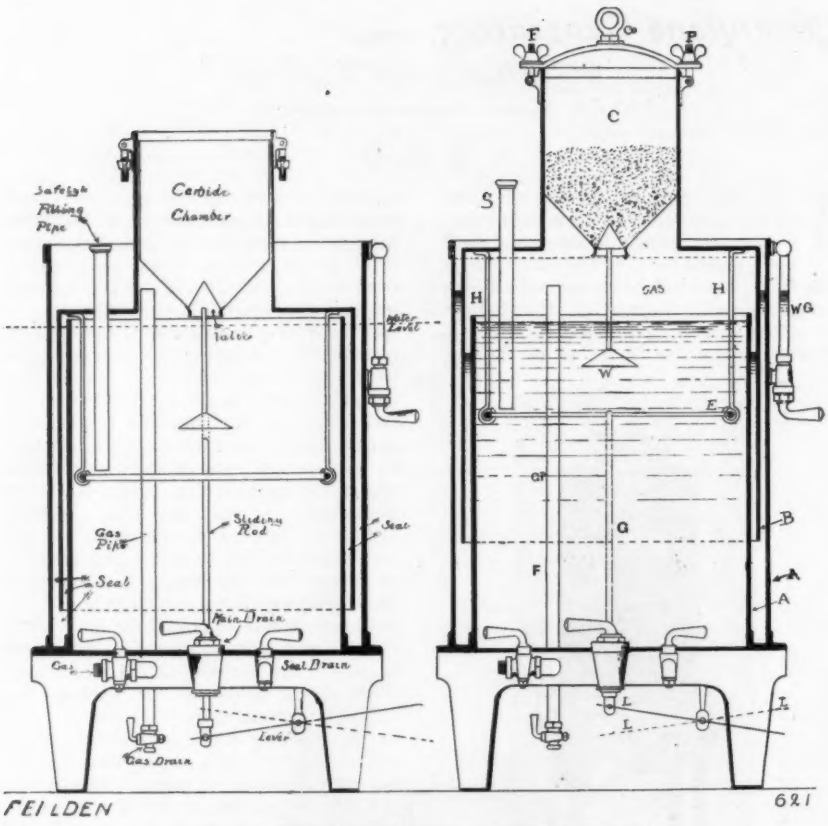

FIG. 42.—SECTIONAL VIEWS OF THE "ACETYLITE" GENERATOR.

The bell is prolonged at the top by a neck of smaller diameter, in which is fixed the conical carbide chamber *C*, containing granulated carbide, and which is closed by a gas-tight cover, fitted at the bottom with a conical valve *D*, having a rod and weight attached to its under side. Below the weight is also hung a perforated grid *E*, somewhat smaller than the inner tank into which it projects. The outlet pipe *F* and rod *G* pass freely through this grid. A water cock, sludge cock, and gas exit cock are provided at the base of the machine. The rod *G* serves to raise the weight and valve *D* as the gasholder falls, thus allowing more carbide to drop into the water on to the grid, whilst as the holder rises the weight brings the valve on to its seat and cuts off the supply of carbide. The height of the rod *G* can be regulated from outside so as to act at any point in the descent of the holder. The carbide used in this generator has to be granulated to a special size, which, of course adds somewhat to the expense.

In working, the generator is filled up to the top of the inner tank until it overflows and fills the seal to the same level, this being shown by the gauge glass. The

FIG. 43.—"ACETYLITE" GENERATOR ADAPTED FOR LAMP-POSTS AND ISOLATED POSITIONS.

carbide chamber is then filled with granulated carbide, and the cover secured by means of fly-nuts and a rubber joint.

The lifting rod is then regulated so as to raise the valve at the bottom of the carbide chamber, and some of the material is dropped into the water below and generates acetylene, which causes the bell to rise, carrying with it the carbide chamber. The weight attached to the valve rod being lifted free of the lifting rod closes the valve and cuts off the supply of carbide. When the bell again sinks, the lifting rod again stops the downward passage of the weight, and again lifts the valve, the action repeating itself until the whole of the charge of carbide is exhausted.

With this form of apparatus there seems to be but little after generation, and the carbide being decomposed near to the surface of the water, very little loss from solution takes place.

A small size of this generator (Fig. 43) is also made to fit into the cavity in the

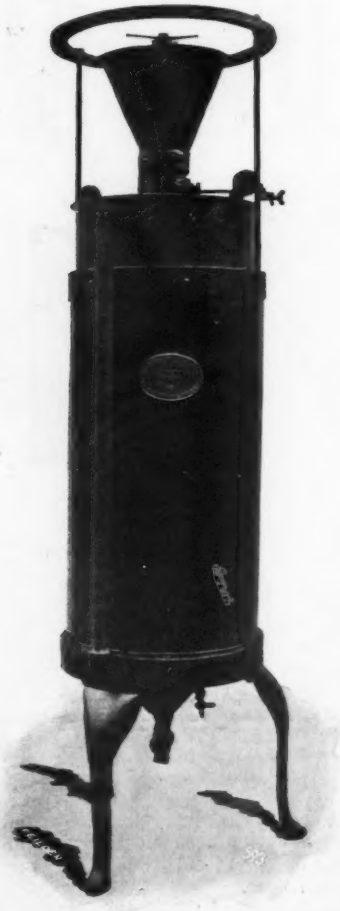

FIG. 44.—THE "SIGURDSSON" GENERATOR.

base of a lamp-post, and is very useful in isolated positions.

The Sigurdsson apparatus (Fig. 14) is another of the same type.

In this generator granulated carbide is contained in a conical hopper fixed to the top of the bell of the holder, this hopper

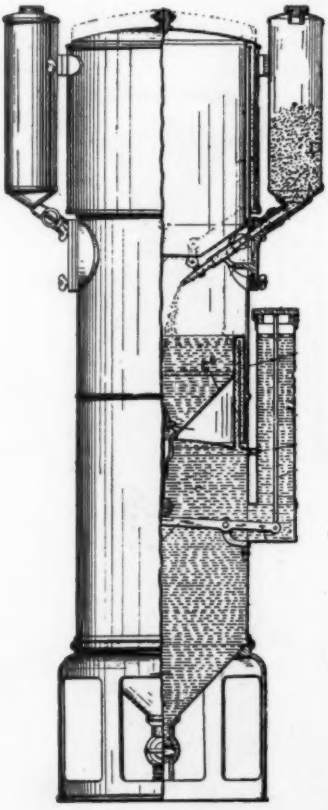

FIG. 45.—"ROSS'S" GENERATOR.

is closed by a sliding valve connected to a shaft having a slotted lever arm which works on a pin fixed in one of the uprights of the holder.

As the bell of the holder descends the lever arm is raised by the pin and draws open the valve, thus allowing a charge of carbide to fall upon a perforated conical disc placed just below the water in the tank, acetylene is generated, and as the bell rises, the lever is pressed down and slides the valve back into position so cutting off the carbide supply.

In Ross's generator (Fig. 45) the automatic supply of granulated carbide to water is brought about by fitting on top of the generator a small rising holder containing a hollow drum. The carbide is contained in two hoppers, fixed on the exterior of the apparatus, having a delivery spout projecting into the generator. This spout is some inches in length, and its central portion is made of flexible tube, whilst the nozzle is carried by a weighted lever working on a bracket which, when the drum in the holder is raised, lifts the spout upwards and stops the outflow of the carbide, but as the drum descends is pressed downwards and allows the outflow of carbide into the water.

Reference to Figs. 46, 47 and 48 will at once make the inventor's intention clear; but one would expect that the arrangement, although highly ingenious, would soon get out of order and clog.

SCREW GENERATORS.

In Strode's generator (Fig. 49), the process of dropping the carbide into water as more gas is required is carried out automatically by means of a water-wheel actuating a cone having a spiral chamber into which the carbide falls by its own gravity, a portion being turned into the water with each movement of the water-wheel. The water acting on this wheel is regulated by the rise and fall of a small gasholder slightly larger at the top than at the bottom, the walls of the gasholder displacing the water in the holder so that it overflows on to the water-wheel, which is provided with pockets, and on one of the pockets becoming full, the wheel gives a quarter turn. The cone piece, being on the same spindle, is turned with the wheel, and the carbide gravitating through the spiral chamber, falls into the water beneath. The water projected from the wheel serves to replenish the water absorbed in the generation of the gas. A water regulating

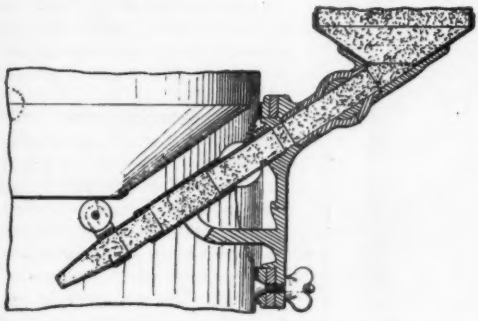

FIG. 46.—DETAILS OF THE "ROSS" GENERATOR.

covered by a box-shaped cover, open at one end, which slips over the carbide container and water-wheel and dips down some distance into the water, thus forming a perfect gas seal, and can be instantly removed or replaced. At the top of this cover is a hopper connected to the cover with a valve. When this hopper requires recharging, the valve is opened to prevent the escape of gas from the generator or the admission of air, and the hopper being opened is then filled with carbide, and after being closed the valve connecting it with the generator is opened and the carbide is free to run into the container beneath.

tank is provided for connecting to the water main with double ball-valves and overflow to maintain a constant level of water in the gasholder when the gas is not being used.

The process of charging the generator with carbide and dealing with the sludge and cleaning out is effected very simply. An overflow is provided to the generator arranged in such a way that any surplus water, in discharging into an overflow tank provided, carries with it the lime formed in the generation of the gas.

A connection is also made between the overflow tank and the generator with full-way valve, so that the sludge and lime can be run off into the overflow tank without interfering with the working of the apparatus in any way.

The working part of the generator is

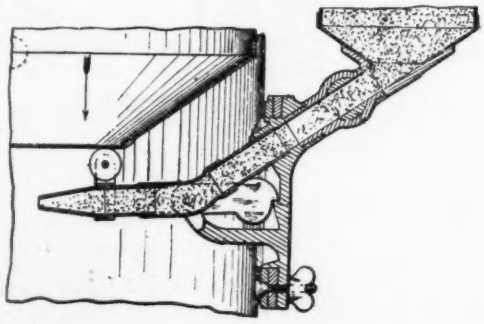

FIG. 47.—DETAILS OF THE "ROSS" GENERATOR.

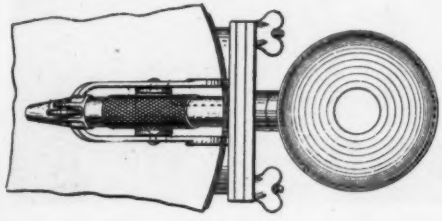

FIG. 48.—DETAILS OF THE "ROSS" GENERATOR.

The "latch" generator is very popular on the continent, but there are no representatives of this type on the market in England at present, whilst the type in which a bottomless holder full of carbide slides on a metal plate over a hole through which the carbide falls into the water in the generator below, is found in the latest form of generator made by the English "Pintsch" Company, and fully described in an article on "An Improved System of Railway Carriage Lighting," to be found on p. 111 of this Magazine.

No automatic generator of the fourth type in which carbide enclosed in a

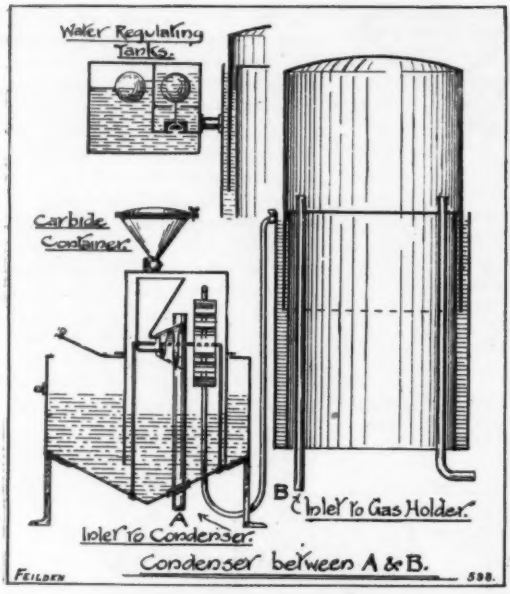

FIG. 49.—"STRODE'S" GENERATOR.

vessel is dropped below the surface of water is to be found amongst the forms of apparatus on the English market, and it is well that it is so, as the water only slowly finding its way into the carbide container is very liable to give rise to overheating.

The carbide into water form of generator when non-automatic lends itself to the simplest forms of construction. In the apparatus made by the Pictet Pure Acetylene Company the generator simply consists of a water container with conical bottom for the separation of the sludge, and a sloping side tube which discharges the carbide on to a grating below the surface of the water, the gas generated by this means being to a large extent purified by the saturated lime water through which it has to bubble in its escape. This apparatus also works well on a large scale, and Fig. 50 shows the arrangement in use for lighting an important church in Lancashire.

In concluding this brief notice of a few acetylene generators which are to be found on the English market, I can only point out that intending purchasers should be governed in their choice of a generator by its practical performances, and that that generator is the best which develops the least heat during generation of the gas, gives the best results as regards volume, and delivers the gas cold, and as far as possible purified at the burner for consumption. If the purchaser has not sufficient knowledge to be able to judge of this for himself, he should insist on a certificate from some one competent to decide that the particular form of apparatus gives rise to no undue overheating, and develops the full proportion of gas.

FIG. 50.—THE "PICTET" ACETYLENE COMPANY'S GENERATOR, ADAPTED FOR LIGHTING A CHURCH.

Although the purity of commercial calcium carbide has greatly improved during the past two years, it is absolutely essential that the gas should be purified after leaving the holder, and before consumption, from the phosphuretted and sulphuretted hydrogen, which it always contains, whilst the elimination of ammonia in the gas is also of importance. At the present time in England the purifiers most in vogue are those working under Frank's system, in which the gas is purified by passing it through an acidulated solution of cuprous chloride, which is used to saturate kieselguhr or other absorbent material, and the bleaching powder purifiers manufactured by Thorn and Hoddle. It is important, however, in using either of these that the gas should be made to pass after purification through a small chamber containing quicklime, to absorb any fumes which it may have obtained from the purifying material.

William B Lewes

The Building of a Great Railway.

The Great Central Extension to London.

(*Continued from page* 479.)

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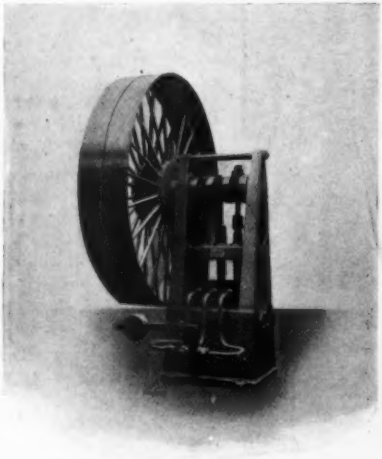
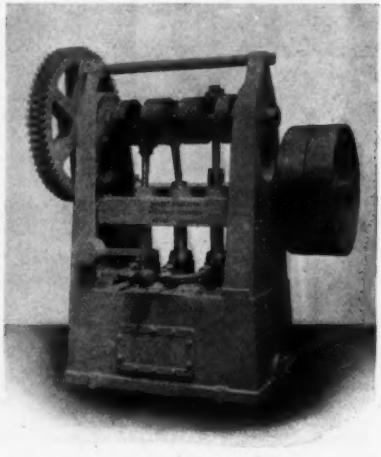
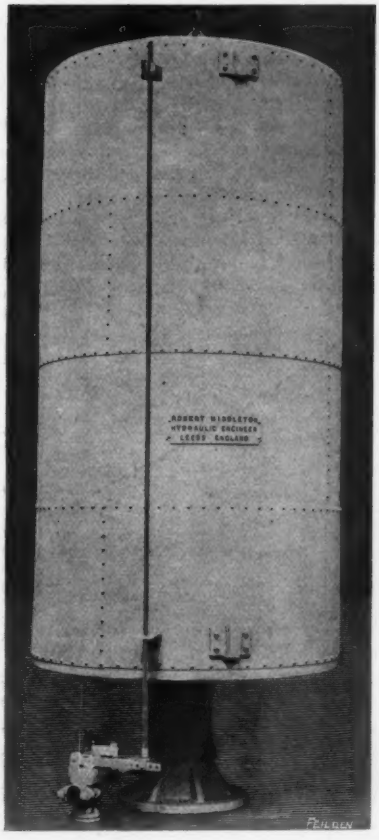
THE hydraulic installations at Leicester consist, as at Nottingham, of engine, pumps, accumulator, elevator, and the necessary piping. In Leicester a 3 h.-p. and at Nottingham a 12 h.-p. Crossley self-starting gas engine is the motive power, and at the latter station this power is in duplicate. The main features of the two installations at Nottingham and Leicester are practically the same, differing only in point of size and power adapted to the extra strain of work. The pumps are of the vertical type, with rams of gun-metal covered with steel. The covering of the hard gun-metal is to prevent the corrosive action of the water. The crank-shaft and counter-shaft are driven in the ordinary way, but with heavy helical spur gearing which, as may be seen from the illustration, is designed to prevent jar or slipping. The connecting rods have adjustable bearings of special pattern, which form an oil bath, in which the pins work a fine screw enabling the top bearing to be adjusted with great nicety. The standards are heavy, and designed to bear the thrust or working strain rather than to allow it to fall on the caps. In this type the cylinder moves, while the ram is stationary. This prevents vibration and the dancing of the accumulator, and sudden shock in opening and



HYDRAULIC INSTALLATIONS AT NOTTINGHAM AND LEICESTER: VERTICAL RAM PUMP



HYDRAULIC INSTALLATIONS AT NOTTINGHAM AND LEICESTER: VERTICAL RAM PUMP, WITH HELICAL SPUR GEARING.

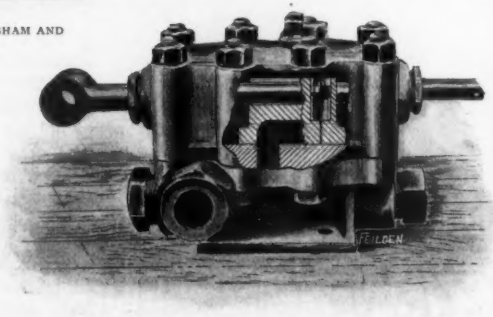


HYDRAULIC INSTALLATIONS AT NOTTINGHAM AND LEICESTER : ACCUMULATOR

closing is prevented by the use of special patterns of valves and valve-seating. The valves are automatically worked by the accumulator. The accumulator is of sufficient capacity to supply the elevator with water for two full journeys without being recharged, and the pumps fill the accumulator in six minutes. One complete journey is made in three minutes. Three cylinders are fitted to each elevator, but when the weight is below, say, 15 cwt. the centre one only comes into action; when that weight is exceeded, the two outside cylinders are utilised, their combined areas being equal to the centre area, and all work proceeds simultaneously. Messrs. Robert Middleton & Co., of Sheepscar Foundry, Leeds—who are the licensees and makers of Curran's patent self-lubricating slide-valve—use these in their lifts, as well as Middleton's Patent Silencer and Regulator. The feature of the valve is its large area; it reduces the friction between the slide and valve faces by as much as 75 per cent.

Although it has no more working parts than an ordinary slide-valve, the Curran's Valve—a part section of which we give, and in which the self-lubricating device is shown—prevents the common nuisance of the fouling of the water by waste grease. The patent regulator is constructed so that the valve may be fully opened when it is ascending or descending, giving a definite and regular speed without the attention of the person in charge, and is silent in respect to the hissing noise caused when the water passes at high velocities through small orifices and found to be very objectionable.

The accumulators are, of course, of sufficient capacity for the number of elevators they have to serve. With a ram of about $4\frac{1}{2}$ in. diameter about



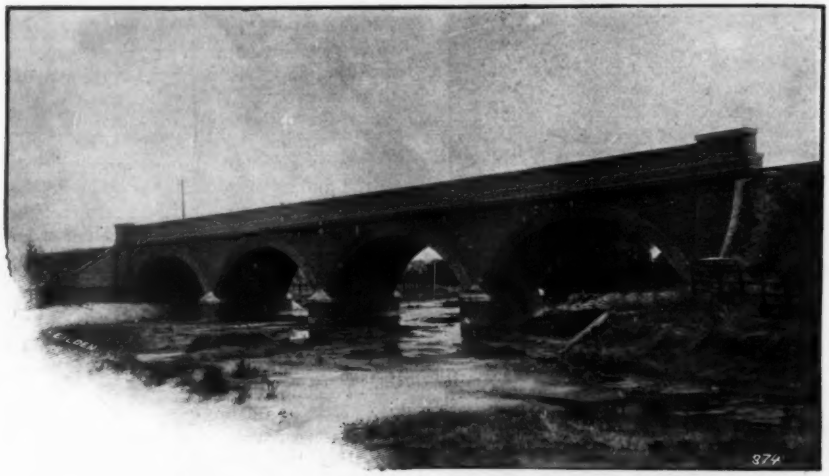
HYDRAULIC INSTALLATIONS AT NOTTINGHAM AND LEICESTER: CURRAN'S VALVE, SHOWING THE PATENT LUBRICATING ARRANGEMENT

a ton and a half may be lifted, and the cages, which are constructed of heavy angle steel 9 ft. 4 in. × 8 ft. 10 in. and 7 ft. high, travel through 40 ft. and over. The Middleton patent grip safety apparatus acts by the use of strong wedges working in steel thrust boxes on to hardwood guides. Both working and safety ropes are made of the very best plough-steel wire.

Proceeding southwards, the line penetrates for a distance of a quarter of a mile through a cutting 20 ft. deep, and immediately afterwards Aylestone Viaduct is reached. As will be seen from the illustration, it consists of a four-span brick arch, built at a skew angle of 60 degrees. The spans are 41 ft. 6 in. The Soar Valley is crossed by an embankment three-quarters of a mile in length at an average height of 17 ft. Nothing of particular interest occurs until the bridge over the canal at Aylstone is reached at 35 miles 51 chains. This is of the lattice-girder type, and has a span of 90 ft. The four main girders are 92 ft. 7 in. long and 8 ft. deep, weighing 27½ tons each. In erecting this bridge trestles were placed in the river and timber thrown across. The main girders reached the site in two pieces, and were carried into position by a special traveller.

Half-a-mile beyond this point the second contract terminates.

Mr. Lovatt is to be congratulated on the excellent way in which the work has been carried out in the short period of two and a half years and in the face of serious difficulties. The fact that most of the section is in the Valley of the River Soar, which had to be crossed ten times, rendered good foundations difficult of achievement. Generally speaking, it was only after sinking 20 ft. through ground, silt, mud, and running sand, and by plenteous pumping as well as timbering, that a satisfactory foundation could be effected.

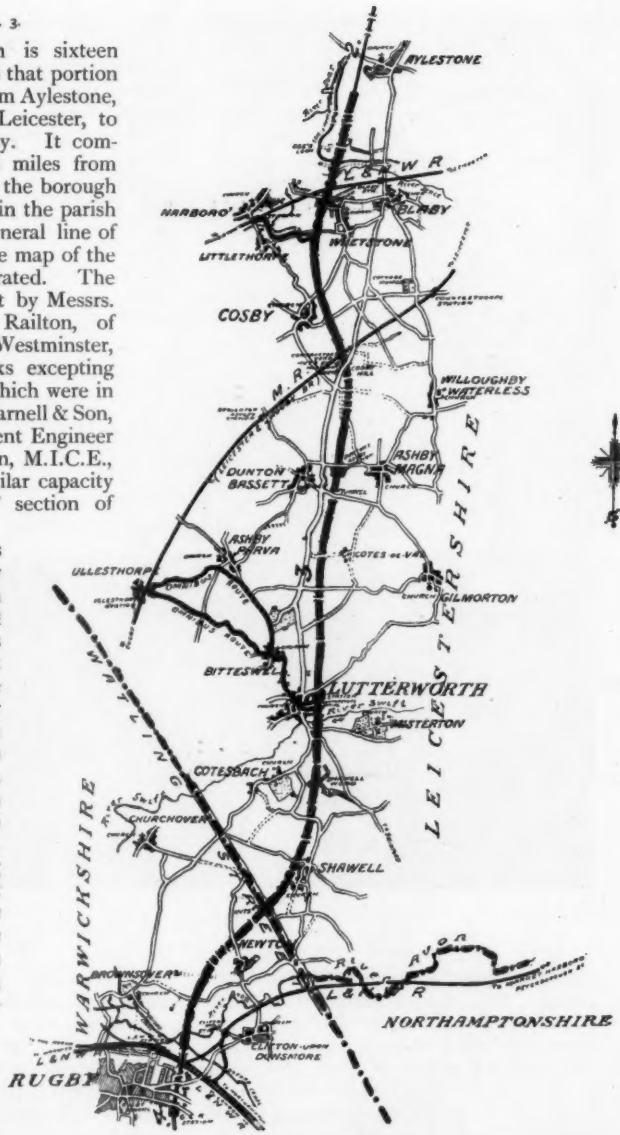


AYLESTONE VIADUCT.

During the contract period of two and a half years nearly 1,500 men were regularly employed, while 6,000 tons of steelwork, 75,000,000 bricks, and 120,000 cubic feet of ashlar were used. The plant included 16 locomotives, 6 steam navvies, 15 steam cranes, 500 tip wagons, 100 spring ballast wagons, 50 horses, and 40 miles of rails.

CONTRACT No. 3.

The contract, which is sixteen miles in length, includes that portion of the line extending from Aylestone, a few miles south of Leicester, to a point close to Rugby. It commences at a point 36 miles from Annesley, just south of the borough boundary of Leicester, in the parish of Aylestone. The general line of route is indicated on the map of the section herewith illustrated. The contract was carried out by Messrs. Topham, Jones and Railton, of Great George Street, Westminster, who executed all works excepting the station buildings, which were in the hands of Messrs. J. Parnell & Son, of Rugby. The Resident Engineer was Mr. A. H. Collinson, M.I.C.E., who also acted in a similar capacity on the first, or "A," section of Contract No. 1.



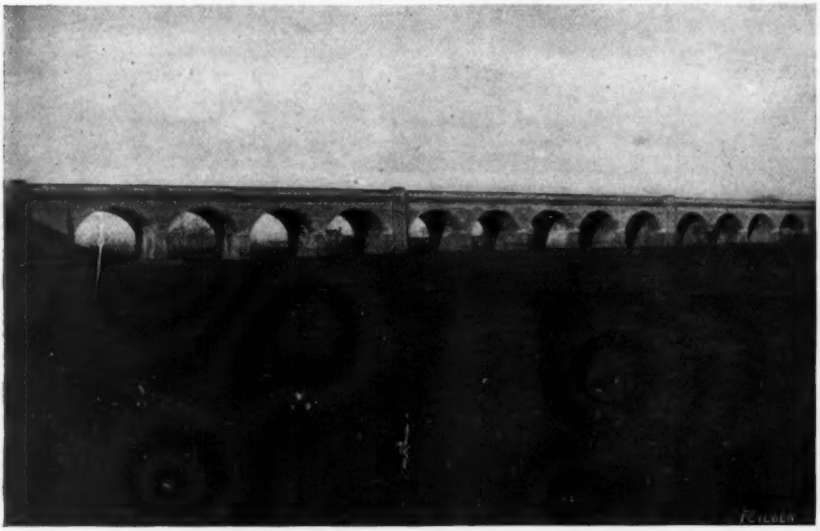
MAP OF CONTRACT NO. 3.

The work, which was generally of a heavy nature, commences with a shallow cutting, and continues for 1¼ miles across alternate short banks and cuttings, the second of which latter being the last in which the Keuper Marl was found, although for a few miles south it was reached in some of the bridge foundations. Following this cutting is one of the longest embankments on the extension, known as the Whetstone Bank, the total length being 3 miles 18 chains, maximum height 44 ft., and cubical contents 850,000 yards. The construction of this bank entailed considerable difficulties, owing primarily to the necessarily long lead, which involved some of the material being brought from cuttings 12 miles distant, and, secondly, to the numerous obstacles which had to be bridged over before tipping could proceed. These points included

the Union Canal, the London and North-Western and Midland Railways, five public and numerous field roads, etc.

Near Whetstone (37 miles 20 chains), the Union Canal is crossed by a steel plate girder bridge, with lattice parapets, flat flooring, and having a clear span of 34 ft. The steel work of this bridge and the 22 others occurring on this section was made and erected by the Horseley Co., Ltd., of Tipton.

A few chains further south the railway is carried over the valley of the River Sence, a small tributary of the Soar, by the Whetstone



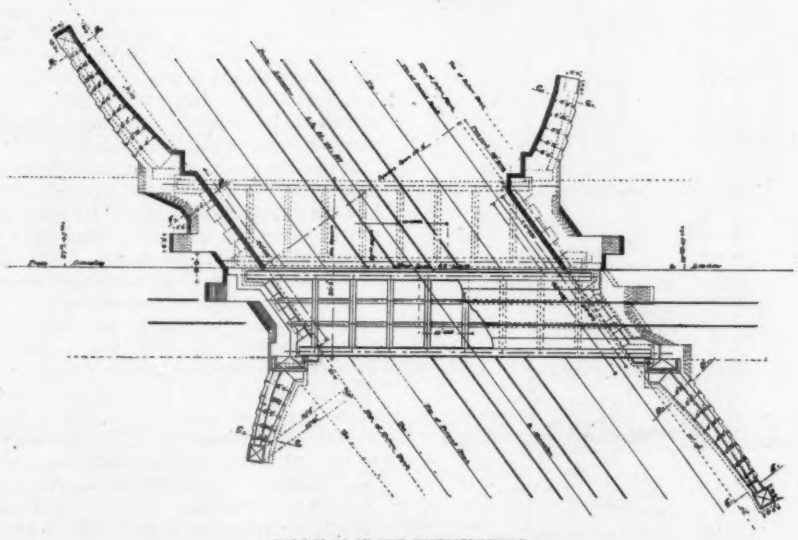
WHETSTONE VIADUCT.

Viaduct, a general view of which is reproduced. The viaduct, which is of brick, has an extreme length of 152 yards, a maximum height of 31 ft., and consists of 13 segmental arches of 30-ft. span, built on the square. The rise of the arch in each case is 10 ft., the thickness at the springings 2 ft. 3 in., while that at the crown is 1 ft. 10½ in. The ordinary piers are 4 ft. 1½ in. thick at the springing, and 4 ft. 6 in. at the ground level. The two abutment piers are 12 ft. and 12 ft. 4½ in. thick respectively at the same levels. They are built with pockets filled with lime concrete, while the foundations, which are carried down to the marl, are of cement concrete. The spandrel filling is of lime concrete, paved with common brick, and the whole surface coated with asphalte. The filling-in over the crown of the arches to the formation level is of granite rubble, cess-pits with outlets taken through the arches being provided for drainage over each pier. The concrete used in the foundations consisted of five parts of broken granite, two of sand, to one of cement. The whole of the work is faced with brindle brick, with ashlar arch quoins and caps.

Soon after leaving Whetstone Viaduct, just to the north of the village bearing the same name (at 37 miles 4 chains), the line crosses over the Leicester and Nuneaton branch of the L. & N. W. Railway by a plate-girder bridge, built on the skew at an angle of 53° 30′ with a clear span of 65 ft. 3¾ in. The constructional features of this bridge call for a somewhat

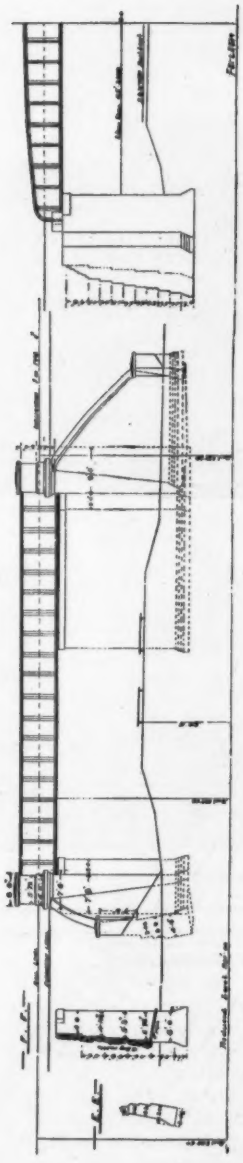
GENERAL VIEW.

HALF-PLAN OF THE FOUNDATIONS.

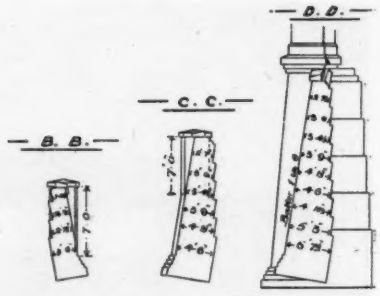


HALF-PLAN OF THE SUPERSTRUCTURE.

BRIDGE OVER THE L. AND N.W. RAILWAY, NEAR WHETSTONE.



BRIDGE OVER THE L. AND N.W. RAILWAY: ELEVATION.



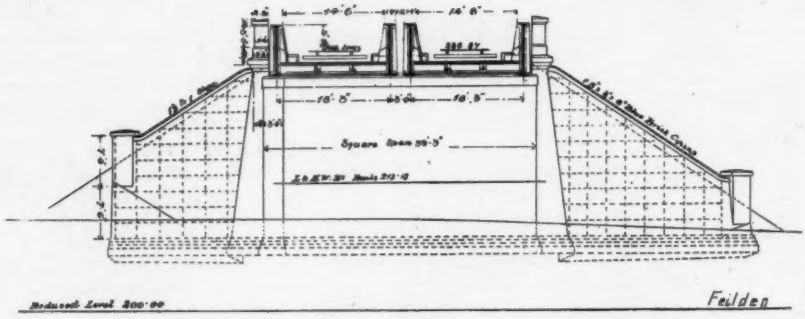
BRIDGE OVER THE L. AND N.W. RAILWAY: SECTION OF WINGS.

close description, to aid which detailed drawings of the abutments and steel superstructures are here reproduced from the working drawings.

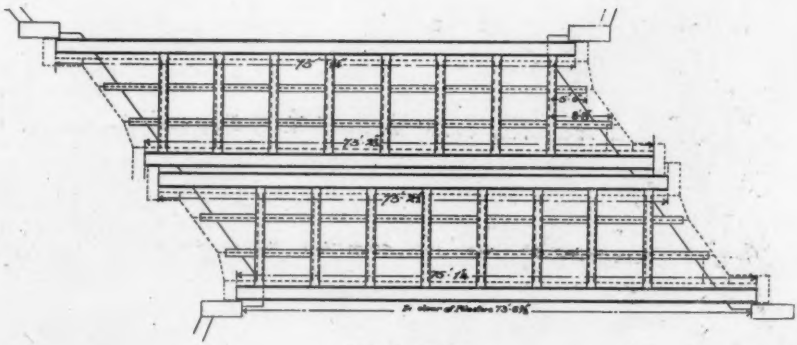
From the transverse section it will be seen that each track is carried by an independent and unconnected pair of plate girders, a distance of 15 in. between the flanges throughout the whole length dividing the two inner girders. The face girders are 75 ft. $1\frac{1}{4}$ in. in length over all, 7 ft. deep with parallel flanges, the upper flange being 1 ft. 9 in. wide, and the lower 2 ft. The inside girders are 73 ft. $2\frac{1}{2}$ in. long with a depth at the centre of 7 ft. The upper flange is curved, and the widths of both upper and lower are the same as those of the face girders.

From the plan, the top half of which represents the foundations, and the lower half the superstructure, it will be seen that the square span is 52 ft. 6 in., which is increased on the skew span to 65 ft. 3 in.

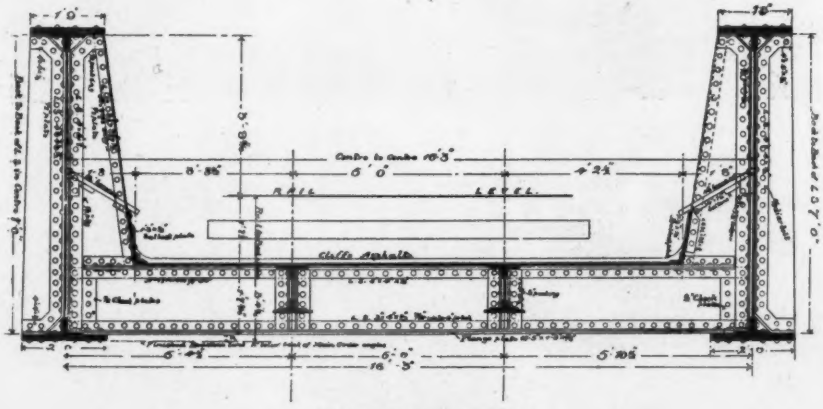
Details of the long and short wings, which have a batter of 1 in 6 and a slope of $1\frac{1}{2}$ to 1, may be clearly gathered from the general elevation, plan and section of wings. Both abutments are 4 ft. 6 in. at the top, and 6 ft. at the commencement of the neat work above the footing courses, as will be seen from the cross section *FF*, to the left of the general elevation. The total height of the abutment is 25 ft. 3 in. A layer of dry rubble, 12 in. in thickness, backs the abutments, from the foot of which a pipe 3 in. in diameter is passed through the abutment to carry off the water.



TRANSVERSE SECTION, NORTH.



PLAN OF GIRDERS.



CROSS SECTION AT CENTRE.

BRIDGE OVER THE L. AND N.W. RAILWAY, NEAR WHETSTONE.

The whole structure is faced with Staffordshire brindled brick.

The flooring of the bridge consists of cross girders, into which are riveted the rail bearers and ½-inch floor-plates, the whole surface being coated with seven alternate layers of asphalte and canvas. The whole of the metal-work in the bridge is steel, and the main girders, each weighing 24 tons, are bedded upon three thicknesses of hair felt, and bolted down to the bed stones

Leaving the North-Western Railway, adjacent Narborough and Enderby quarries. At Whetstone, also, the contractors formed a connection with the London and North-Western Railway, by means of a branch line upwards of a mile in length, over which they transported the whole of the materials used in the construction of the works, as well as the ballast which was largely obtained from local quarries.

At 38 miles 15 chains, a three-arch tunnel bridge had to be constructed, the centre span carrying the Whetstone brook,

LEICESTER ROAD BRIDGE (40 MILES 54 CHAINS).

the line crosses in succession the main road from Enderby to Blaby at 37 miles 52 chains by a steel plate-girder bridge, 40-ft. span, of the 3-girder type, and the public road from Enderby to Whetstone at 37 miles 69 chains, by a bridge similar in construction.

At Whetstone, four miles from Leicester, a station on the high level has been provided, the distance from Annesley at this point being 38 miles. At Whetstone, special provision has been made for loading stone and granite, obtained from the and the side spans accommodation roads. The latter were also designed to serve as flood openings. The height of the bank at this point is 45 feet, the length of arches and wings over all is 250 feet. Some idea of the magnitude of the work can be gathered from the fact that the quantity of brickwork used in construction was practically identical with the Whetstone Viaduct.

At 38 miles 25 chains, the line is carried over the road from Whetstone to Narborough on another tunnel bridge, having

DUNTON BASSETT TUNNEL.

a single segmental arch of 26 feet direct span. This bridge is built slightly on the skew, at an angle of 70°. The length of the arch being considerable, the central portion was built on the square, the faces only for about 10 feet being turned on the skew. The junction of the square and oblique parts of the arch were made by a series of radial courses, none of the bricks being cut, and special stone springers were provided to receive the additional courses in the skew faces.

The embankment continues, passing over an occupation road at 38 miles 73 chains by a small span girder bridge, and over a public road at 39 miles 19 chains by a plate-girder type bridge with lattice parapets of 33 ft. span.

The village of Cosby is reached at 40 miles 30 chains, where the Rugby and Leicester branch of the Midland Railway —the original main line—which is in a cutting, is crossed by an ordinary plate-girder type bridge of 29 ft. span. At this spot the contractors established their yard, and erected a locomotive shed, offices, repairing shops and workmen's dwellings.

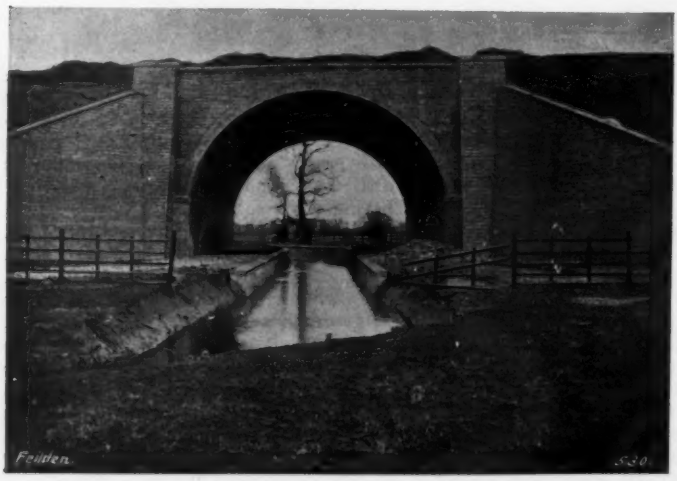
The Whetstone bank terminates here, and a long cutting is entered, which revealed in opening a change in the geological conditions, the blue lias clay which continues to the end of the northern division being first met with. The cutting is $1\frac{1}{2}$ miles long and necessitated 300,000 cubic yards of excavation. At 40 miles 54 chains the main road from Leicester to Rugby is carried over the railway by a brick bridge having three segmental arches of equal span, built obliquely at an angle of 40° 10′. The direct span is 26 ft., the skew span being 40′ $3\frac{11}{16}$″. The rise of arch is 10 ft., the thickness throughout 1·92 ft., radius 13·45 ft., heading spiral 46·83 ft., and length of impost 66·667 ft. The piers, which are founded on hard blue clay, are 4 ft. $1\frac{1}{2}$ in. thick at the springing, and 4 ft. 6 in. at rail level. The width between parapets is 4 ft. The quoins and springers with raised checks are of stone. A view of this bridge is given.

Continuing, the line runs for some miles

LUTTERWORTH STATION AND YARD.

parallel to the Leicester main road, with nothing of particular interest to call for attention, to Ashby Magna, where there is a low level station of the ordinary type provided with cattle docks, sidings, etc. At the south end of the station a deep cutting commences, containing 307,000 cubic yds. In the middle of this cutting the line passes into a short tunnel, 94 yds. long, named after the adjoining village of Dunton Bassett, which is in many respects similar to the East Leake tunnel which has been described.

From Ashby Magna to Lutterworth the country is of an undulating nature, and at Gilmorton, 12 miles from Leicester, the highest point of this division of the line is reached, the surface level being 455 ft. above ordnance datum. Passing several small span bridges the line descends by a gradient of 1 in 176 to the town of Lutterworth, which is reached at 46 miles 24 chains. The station is on the high level with sunk approaches, and is provided with a station, yard, cattle pens, milk dock and platforms, approach roads, etc. Some difficulties were met with in building the foundations for the bridge from which the entrance to the platform is obtained owing to running sand being encountered, which necessitated the trenches having to be sheet piled and other special provisions made.



BRIDGE OVER THE RIVER SWIFT AT LUTTERWORTH.

Lutterworth is one of the towns which will reap a special benefit from the line, as it has hitherto been without railway

RUGBY ROAD DIVERSION, LUTTERWORTH.

WALCOTE ROAD BRIDGE, LUTTERWORTH.

BRIDGE OVER WATLING STREET.

accommodation, the nearest station having been 3½ miles distant. A considerable trade is done in the place, principally in connection with cotton goods and stockings.

The River Swift runs through Lutterworth, and a high embankment was necessary to carry the railway across the valley. The river, which is very liable to flood, is spanned by a tunnel-type arch bridge of 45 ft. opening, the details of which are practically the same as those for the bridge over the River Avon at Rugby, drawings and descriptions of which are given later on.

Further south it was found expedient to divert the main roads from Lutterworth to Walcote and Market Harborough to Rugby, the former to Walcote being taken under the railway at a lower level than the old road, while the Rugby road was diverted on the west side of the railway, and continued parallel to it for about 20 chains until it joined the original road again. The lengths of road in both cases were shortened, and the gradient much improved. A bridge was provided carrying the road to Swinford in its original position, across the cutting, at 46 miles 66 chains.

The bridge over the Walcote Road is a type adopted for carrying the railway over main roads in Leicestershire, a similar case occurring at Watling Station which is spanned further on.

The span on the square is 40 ft., the rise of the arch 13 ft. 4 in., thickness at haunches 2 ft. 7½ in., decreasing to 1 ft. 10½ in. at the crown. The first two rings are built in English bond, and the remaining rings bonded whenever possible. The backing is of lime concrete, paved with brick on the flat, and the surface coated with five layers of canvas and asphalte. The splayed wings, which are curved, have a batter of 1 in 6.

Leaving Lutterworth the line runs through a long shallow cutting, commencing at 47 miles 5 chains, and terminating at 49 miles 7 chains. It contains 285,000 cu. yds., is crossed by several public and accommodation roads, and passes through the village of Shawell. On an embankment half a mile south of this village, at the crossing of Watling Street already referred to, a site for a future station has been provided. Under the bank at this point is a culvert of 8 ft. span, 350 yds. in length, carrying a stream

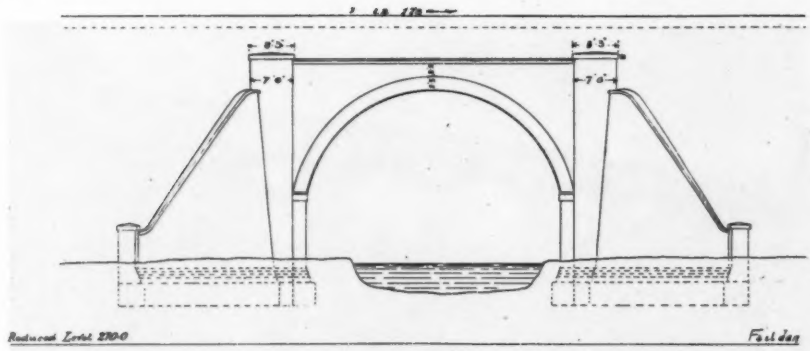
NEWTON LANE BRIDGE (50 MILES 25½ CHAINS).

diversion. Besides being very sidelong, the ground forming the seat of this embankment consisted for a considerable depth of water-logged peat, which required very careful draining and benching. Before any tipping was started, glazed earthenware pipes in rubble trenches were laid transversely at intervals of about 30 ft. apart and connected to a heading drain. In addition to this a deep trench was excavated on the high side of the land, filled with rubble, with pipe lead to outfall, to intercept the water from the numerous soaks and springs in the hill.

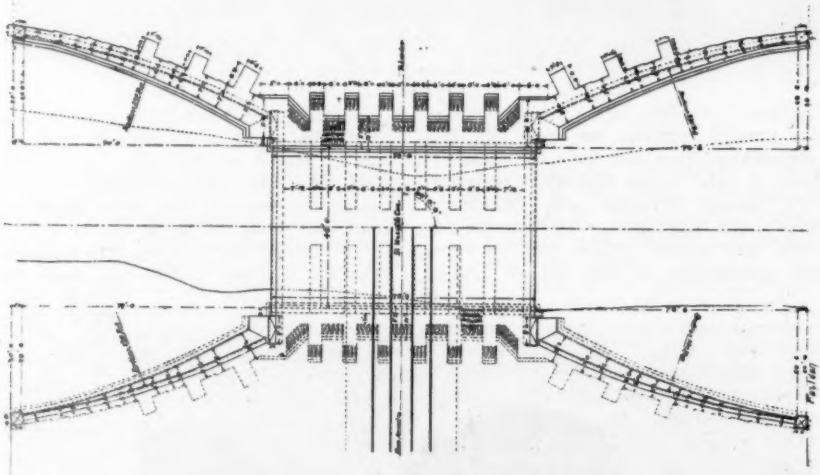
The bridge over Watling Street, a view of which is given, differs only from the bridge over Walcote Road described on a previous page, in that the arch is turned on the skew, instead of on the square.

BRIDGE OVER THE RIVER AVON: CENTREING FOR ARCH.

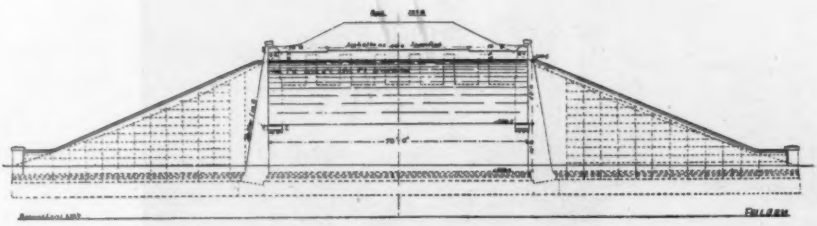
Half a mile further south a deep cutting, passing through the village of Newton, occurs, the public road crossing the railway



ELEVATION, EAST.

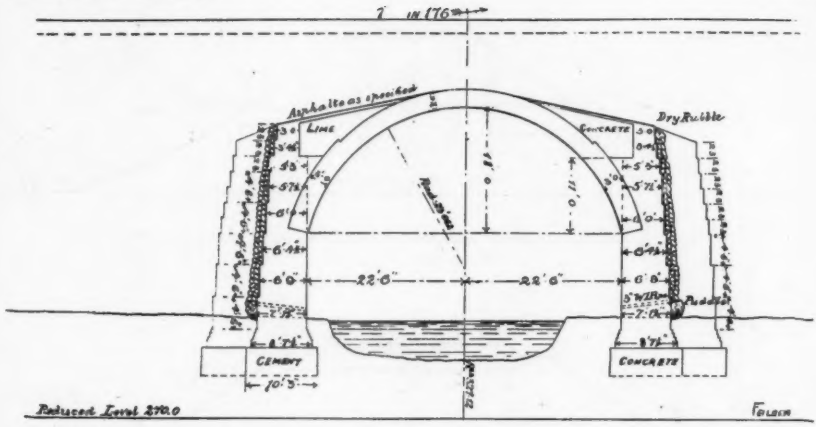


PLAN.



LONGITUDINAL SECTION.

BRIDGE OVER THE RIVER AVON.



BRIDGE OVER THE RIVER AVON: TRANSVERSE SECTION.

obliquely at nearly its deepest point. It is carried on a 5-arch bridge, the skew angle of which is 56°. The spans of the arches vary, the centre opening being 30 ft. on the square, the two intermediate arches 28 ft. and the two side arches 26 ft., while the rise of the arches is 11 ft. 6 in., 10 ft. 9 in., and 10 ft. respectively. The height of the bridge from the railway formation to the road level is 41 ft., the width between the parapets 25 ft., and the length of parapet, which cambers 9 in., 235 ft. The bridge is built on a gradient of 1 in 58. The piers, which have a batter of 1 in 30, are 3 ft. 9 in. thick at the springing level and 7 ft. 10½ in. at the footings. As in all other bridges, the whole of the external work is faced with Staffordshire brindle brick; the quoins, arch springers and caps are of ashlar, while the copings are of Staffordshire blue brick.

The valley of the River Avon is crossed on an embankment which attains a height of 45 ft., and, although only 20 chains in length, contains 150,000 cubic yards of material.

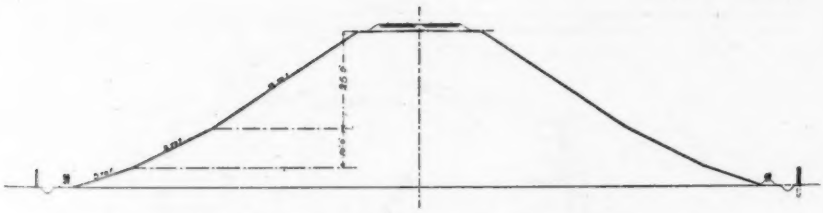
The river itself is spanned by a segmental arch bridge of the tunnel type, built on the square with a single span of 45 ft. and has about 10 ft. of embankment above the crown of the arch. The drawings are reproduced, from which all the details may be followed. An illustration showing the centreing for the arch is also given.

The abutments are 73 ft. 6 in. in length on the face, and have curved, splayed and battered wings carried out to the toe of the slope, the distance right through from newel to newel being 222 ft. 8 in. The arch, which is 3 ft. thick at the haunches and 2 ft. 7½ in. at the crown has a rise of 18 ft., and is faced in English bond. The abutments vary in thickness from 7 ft. 1½ in. to 5 ft. 5½ in. with counterforts 3 ft. 9 in. wide and 6 ft. apart. Walls 3 ft. 9 in. thick, at 6 ft. intervals, are carried up over counterforts in the backing to the arch, the spaces between being filled with lime concrete paved over and asphalted.

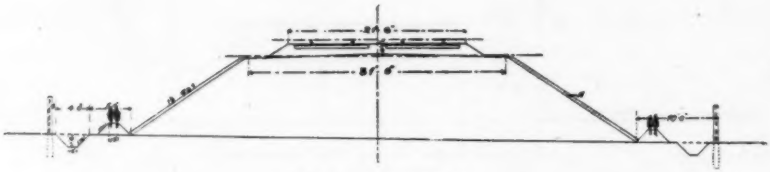
The contract—the last on the Northern Division—terminates at the north end of of the viaduct, over the Oxford Canal, 51 miles 69 chains from Annesley.

Generally speaking, the earthworks were very heavy, upwards of 2,000,000 cu. yds. of material having had to be excavated and tipped to form embankments, road approaches and station-yards. Of this quantity 850,000 yds. went into the Whetstone bank alone.

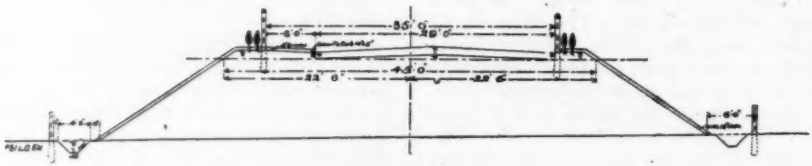
Sections of the various types of cuttings and embankments employed on this section are illustrated and need scarcely any



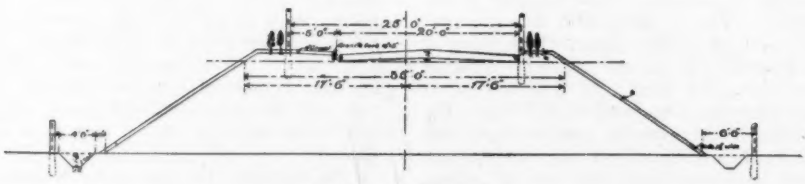
RAILWAY EMBANKMENT, EXCEPTIONALLY HIGH, SOUTH OF LEICESTER.



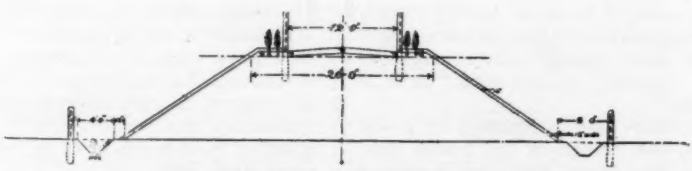
RAILWAY EMBANKMENT.



T. & R. ROAD EMBANKMENT.

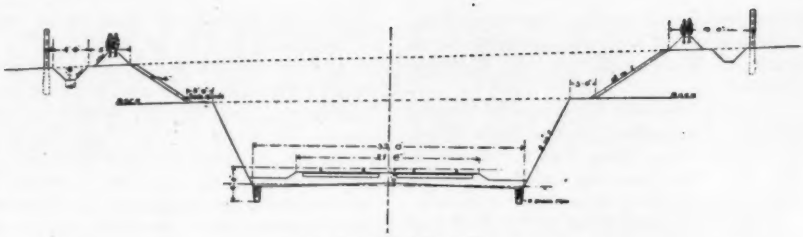


PUBLIC ROAD EMBANKMENT.

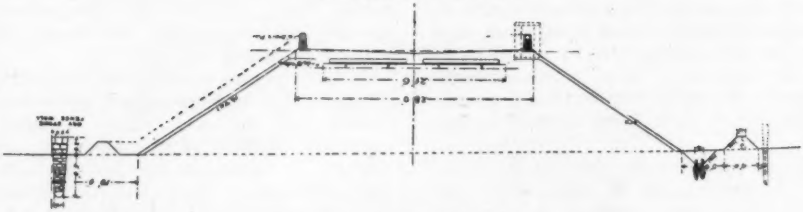


OCCUPATION ROAD EMBANKMENT.

TRANSVERSE SECTIONS OF EMBANKMENTS AND APPROACHES, NORTHERN SECTION, G.C.R.

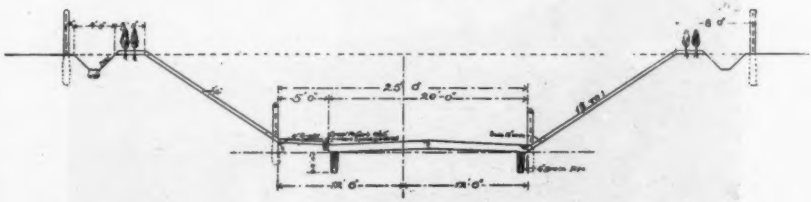


RAILWAY CUTTING IN ROCK.

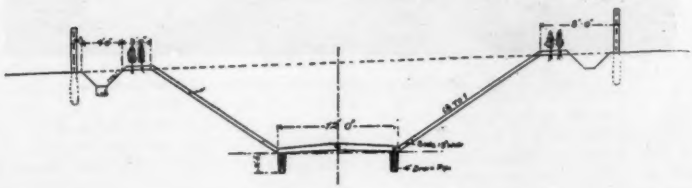


RAILWAY CUTTING IN SOFT SOIL.

T. P. ROAD CUTTING.



PUBLIC ROAD CUTTING.



OCCUPATION ROAD CUTTING.

TRANSVERSE SECTION OF CUTTINGS, NORTHERN SECTION, G.C.R.

explanation. A section of a railway cutting in rock is also given, although none occur south of Nottingham on the Northern Division.

Another section illustrates a cutting through the boulder clays south of Whetstone, the slopes being 2 to 1. North of this, where the marl was found, the slopes were trimmed to 1½ to 1.

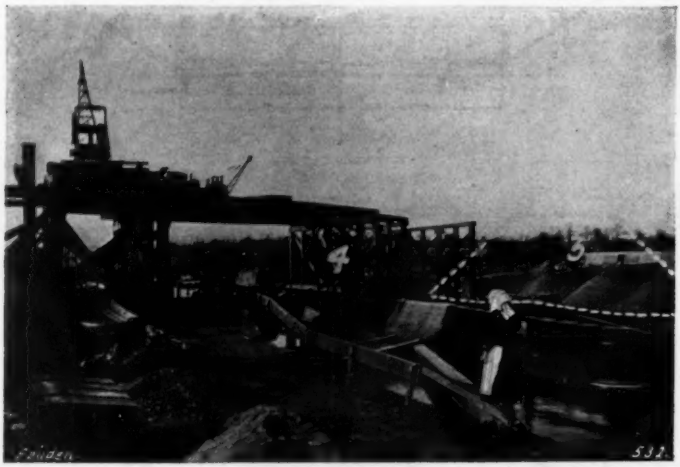
Further sections illustrate types of embankments adopted south of Leicester, in particular, one of a high embankment with compound slopes, commencing at the base at 3 to 1, changing to 2½ to 1, and again at the apex to 2 to 1. Such embankments were tipped in three lifts, no greater height than 20 ft. being allowed in one lift.

Great attention was paid to the drainage of cuttings, in all cases, before any excavation was started, a heading drain was put in on the high side, to which all intercepted land-drains were connected.

Difficulties occurred in several cuttings in the shape of water and running sand, which was encountered, underlying the clay. The latter had to be carefully dealt with, and provision for drainage made.

Throughout the section 35 miles of glazed earthenware pipes of all diameters were required, and upwards of 50,000 tons of Croft granite, hand packed, in arched rubble drains, trenches and counterforts draining and supporting the slopes of embankments and cuttings.

It is interesting to note that the work of tipping the Whetstone Bank, which was carried on day and night, occupied eighteen months. This represents an average of 1,800 cu. yds. per day and night from commencement to completion, no allowance being made for bad weather, etc.



JUNCTION OF NORTHERN AND SOUTHERN DIVISIONS: END OF CONTRACT NO. 3.

(To be continued.)

MACHINERY, APPLIANCES AND PROCESSES.

"Every part and side of our life, from the cradle to the grave, has been touched and tended by the inventor and manufacturer. His works are as numberless as the sands of the sea, but the onward rush of Science and the Arts opens up new fields of discovery and enterprise as each day dawns. Let us choose here and there among thousands, and in choosing take the best as far as in us lies."

THE BIRMINGHAM GUN TRADE.

NEW COVERED RANGE.

THE provision of shooting ranges easily accessible from populous centres has become a matter of great anxiety, particularly to Volunteer officers. Now that the range of a rifle bullet is measured by miles, some of the old ranges have been declared unsafe and substitutes are hard to find.

Land will not be obtainable for such a purpose unless the public can be ensured not only against danger but against alarm. This problem has recently been forced upon the attention of the guardians of the Birmingham proof-house, and though the range they have constructed is only for trade tests and sighting purposes, their solution of it has an instructive bearing upon the general question.

The new range stands upon ground in the populous suburb of Small Heath, about two and a-half miles from the centre of the city, purchased in 1875. Rifle ranges from 100 to 1,500 yds. in length were at that time constructed with very wide and high protecting butts—50 ft. by 50 ft.—and perforated screens. Under the direction of Government experts most elaborate precautions were adopted against possibilities of ricochet, even against chances which some members of the trade estimated at a million to one. These, however, did not avail when the owner of some adjoining land applied for an injunction against the guardians. The range, upon which £12,000 had been spent, in addition to £14,200 paid for the land, was closed beyond 300 yds.

The Great Western Railway Company, whose line adjoins the range, recently purchased from the guardians 43 acres of their land for £16,500, stipulating that the range should be reconstructed in such a way as to ensure absolute safety, and promising £1,500 towards the work if it were carried out to their satisfaction. This is the task which Mr. W. Hawley Lloyd, the architect to the guardians, has just successfully completed. He was instructed to design a series of close ranges, one of 50 yds., three of 100 yds., and one each of 150 yds., 200 yds., and 300 yds. The essentials were perfect lighting of the firing stations and targets, an absence of smoke from the covered portions, and an absolute security against the escape of stray bullets.

Mr. Lloyd had no precedent to go upon. Nothing of the kind had been attempted in England before, and though a range had been constructed at Liège for a similar purpose, the conditions were so different that no help was obtainable from the description of it that was supplied. The buildings as they stand are the result of careful calculation and experiment.

The 300-yds. range (of which a section is given) is a gallery 10 ft. wide by 11 ft. high. Its sides are of brick and the roof, which is flat, is of concrete in which is embedded a layer of expanded metal, while above asphalte to the depth of 1¼ in. is laid as a protection from the weather. The gallery also serves for shooting at 150 yds. and 200 yds. To light the targets a portion of the roof, 10 ft. square, just in front of the target at each of the three distances, is replaced by a shutter of ⅜-in. steel. This slides by means of rollers and T-iron rails in the direction of the length of the building. A rack and pinion run centrally, the teeth being designed to reduce the friction to a minimum, and by means of double bevel-gearing, worked by a windlass handle outside the gallery, the shutter, weighing one and a-half tons, can be opened or closed in a

LONGITUDINAL SECTION OF BIRMINGHAM PROOF-HOUSE.

quarter of a minute. The floor of the range is of engine-ashes. The natural fall of the ground towards the 300-yds. target has been reduced to 3 ft., and corrected by an artificial rise about 7 yds. in front of the target. From the front of the target to the back wall of the butt the roof has a height of 14 ft. with an abrupt "return" by a curve to the lower level. Angles taken from the firing ports, as well as experiments, show that under these conditions the escape of a bullet either directly or by ricochet through the lighting opening is impossible. The butt consists of a bed of red casting sand 10 ft. deep, and having a slope of 45 degrees. Targets of paper and canvas on wood frames are used in preference to steel targets in order that the "patterns" may be more easily and accurately copied.

The firing station is separated from the range by a screen of 4-in. timber, in which is a porthole, 12 in. by 10 in. The firing-table (specially designed by Mr. S. B. Allport, the Proof-Master) is 18 feet from the porthole. This arrangement has been the subject of some criticism, but the steel plates with which the portholes are defined have already been in similar use for four years, and have never yet been struck by a bullet. A hopper surrounding the porthole serves to divert the wads. The firing station is partly open, and an open space between the screens and the end of the covered range allows the escape of any smoke that may have been driven through the porthole. The three 100-yds. ranges are of similar construction, except that while the firing stations are separate, the ranges are under one roof of 30-ft. span, which is carried on joists of rolled steel. It has been ascertained that the targets are more clearly visible, as seen through these covered ranges, than they would be if the shooting were carried on in the open. For the safety of the marker, the door in the timber screen has been so contrived that as long as it is open the firing-port is closed by a steel flap painted red, and an electric bell continues ringing. There are ranges in the open of 40, 60 and 80 yds. for the testing of shot guns, while the buildings in the vicinity of the firing stations include an office, an instrument room, workshops for adjusting sights, &c., and a smithy for regulating gun-barrels. With roadmaking, the building of a lodge, and other incidentals, the cost of the work has been about £5,500.

It has been suggested, that out of the balance of the money received from the Great Western Railway Company, something should be done by the guardians for technical instruction in directions likely to be beneficial to the trade. No scheme,

however, is before the guardians. The Gunmakers' Association, an independent organisation, representing the registered Gunmakers, has, in conjunction with the Gunworkers' Union, placed nine boys in the Municipal Technical School, but the School has no special gunmaking department, though a year or two ago a series of lectures was delivered on the history of the rifle. All gunmakers and gun-barrel makers rated at £25 per annum are entitled to be registered as members of the trade, to vote in the election of guardians of the proof-house, and no doubt the guardians will await the mandate of their constituency before taking the matter seriously in hand. Another proposition made at the opening ceremony was that of Mr. John Rigby, the veteran shot and Chairman of the London Gunmakers' Union, that Birmingham and London should unite to provide laboratories for such purposes as testing the power of explosives, and the tensile strength of metals. But while Birmingham gunmakers have their trade franchise, the London proof-house is in the hands of a self-elected City Corporation.

Paris International Exhibition, 1900.

The greatest book on the greatest Exhibition the world has ever seen will be FEILDEN'S Special Issue for June, 1900.

MAXIM 37-M/M AUTOMATIC GUN.

WE give some particulars, and an illustration, of the 37-millimetre Maxim Automatic Gun, which will be of interest at the present time, seeing it is the first occasion this weapon has been used in civilised warfare. The gun fires a shell weighing about 1¼ lbs. at the rate of 300 rounds a minute, and has an effective range of about 2½ miles. The gun itself weighs 3 cwt. 2 qrs. 24 lbs., the carriage amounting to about the same.

This gun, being automatic, may be turned in any direction with absolute freedom and facility, whilst it is being fired. This renders it very much superior to other machine guns, especially when firing from a moving vessel or at a moving target. Perhaps the best illustration of this might be found in an account of some competitive trials which took place in Russia. Five Hotchkiss guns of the same calibre, and each gun having five barrels, and worked by four men, were ordered to be fired from a rapidly sailing war-vessel on a moving torpedo-boat. The Hotchkiss guns weigh about 1200 lbs. each, while the Maxim gun and its mounting weigh little over 500 lbs., and is fired by one man only. The Maxim gun, however, on the occasion in question, made more hits than were

THE 37-M/M MAXIM GUN, IN USE IN THE TRANSVAAL. THIS GUN FIRES A 1¼-LB. SHELL AT THE RATE OF 300 PER MINUTE.

made with the five Hotchkiss guns. This was not altogether due to the rapidity of firing, although the rapidity was very much greater than with any single one of the Hotchkiss guns, but the bullets were so near together in the air that the gunner could see where they were hitting, and as the gun was perfectly free to be moved, requiring no training gear as is the case with guns which are worked with a crank, he was able to keep the stream of bullets on the target, and therefore, as stated, made more hits with the one gun than were made by the five others, having 25 barrels and 20 men, put together.

As to the present South African war, the Boers have several batteries of these guns, and they are also used in some of their fortifications, but these were supplied some years ago with the full knowledge of the Home authorities. This type of gun is also used in the Russian, French, German, and American Navies. The Americans have lately made a large number of these guns at their own works in Washington, D.C., and they, as machine guns, are found to be very much superior to the ordinary Gatling or Colt machine guns, which fire nothing but rifle ammunition. As these Maxim guns weigh but little more than the regular Gatling, and fire with about the same rapidity, it will be seen they are much more effective, that is, the Maxim fires 300 1¼-lb. projectiles, or 375 lbs. of explosive projectiles in a minute, as against about 10 to 15 lbs. of lead bullets. The range also is much greater. The accuracy of firing at sea is very much greater, because the exploding shells show the gunner at once where his projectiles are striking.

In addition to the large number of these machine guns which have been supplied to the United States Government, Messrs. Vickers, Sons, & Maxim have supplied them also with a large number of Maxim's 6-pr., a gun which can be fired with greater rapidity than any other 6-pr. in existence.

The Binding Cases . . .

for Vol. 1 of FEILDEN'S MAGAZINE will be works of art. Subscribers can have a choice of two covers, one in cloth, the other in half-roan. Both will have a dark green ground, with a strikingly elegant and appropriate design in light green beautifully emblazoned in gold. Prices and full particulars on application to our Publishing Offices.

AN INSTRUMENT FOR LOCATING AND PROJECTING SOUND.

THE illustration we give shows an instrument which has been designed by Mr. Sherard Cowper-Coles for the purpose of readily locating the direction of a sound, and for projecting sound long distances.

The instrument consists of a reflector mounted on an arm which can be readily turned on its centre and depressed or elevated by the operator.

When it is desired to ascertain the exact direction from which a sound emanates, the apparatus is turned on its axis. As soon as the reflector is opposite the source of sound, it is heard much intensified in the receiver. When it is desired to carry on conversation between two distant ships or points, two instruments are used, so that the beam of

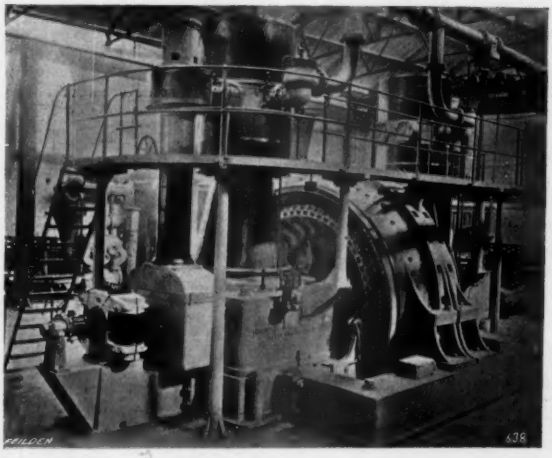
sound is thrown from one reflector to the other, the sound being focussed in the instrument of the receiver. One of the operators speaks into a flexible tube, whilst the operator working the other instrument places the tube attached to the receiver to his ear; conversation can thus be carried on at long distances without unduly raising the voice.

Experiments have recently been made with this apparatus at St. Margaret's Bay, near Dover, when satisfactory results were obtained; even the ticking of a watch, when placed in the focus, could be heard by observers at a distance of some twenty feet, although a strong breeze was blowing across the line of direction of the sound at the time. The reflectors in these instruments are made entirely by electro-deposition.

We understand that, shortly, some experiments will be made to determine the maximum range of this instrument, when we hope to report the results obtained.

DEVELOPMENTS IN ALTERNATE-CURRENT DYNAMOS.

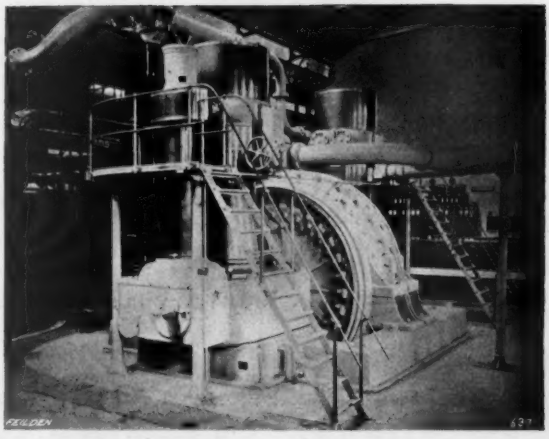
TWENTY years ago dynamo construction was such that machines which would develop about 15 kilowatts were considered large. Their design was very unmechanical. The armature cores consisted of a bundle of iron wire, which was secured to the driving shaft through wooden hubs; the commutators were so constructed that they would not stand more than 200 or 300 volts pressure, and the sparking caused not only brushes to be frequently renewed, but also the whole commutators.



To-day, dynamos are to be found fully 100 times as large as they were twenty years ago, and the inductor-alternator invented by Mr. W. M. Mordey some years back — but only comparatively recently adopted — admits of such excellent mechanical construction as to leave nothing to be desired. In the first place, no coils whatever are revolved, the revolving portion of the machine is nothing more than a fly-wheel with a serrated edge, and the stationary part comprises a cast-iron ring, with a laminated iron face towards the "rotor," in which coils of wire are laid, either through holes or slots. The serrated fly-wheel constitutes the magnets and is excited by a single stationary coil. In the alternating-current system no commutator is employed, so that any difficulties on that head are entirely disposed of.

In the 600-kilowatt inductor-alternator recently erected by the Brush Electrical Engineering Company in the Sheffield Corporation Electric-Light Station, the construction is even more mechanical than indicated above; for, in place of coils of wire, slotted copper bars about $\frac{1}{2}$ in. in diameter are threaded through holes in the stator and joined to one another by mechanical clamps. Each bar is insulated by a mechanical process with compressed mica and paper. The construction of such a machine is now purely a matter for the mechanical engineer as opposed to the electrician.

This inductor-alternator is direct coupled to two Raworth Universal engines —one at each end of the shaft, as shown in the



FRONT AND BACK VIEWS OF THE 600-KILOWATT INDUCTOR-ALTERNATOR ERECTED IN THE SHEFFIELD CORPORATION ELECTRIC-LIGHT STATION BY THE BRUSH ELECTRICAL ENGINEERING CO.

illustrations, which give both a front and back view. The entire set was built by the Brush Company at their Falcon Works, Loughborough, and present an appearance at once massive and business-like. In the design of this plant the Brush Company ventured beyond the beaten track, in so far that they constructed for a periodicity of 100 per second, but the results have more than justified this faith, for they have not only surpassed the guarantees, but exceeded even the anticipations of the designers themselves. These results are no mere matter of experimental running, as the set has been in beneficial use since the 9th of August, on which date it passed its 8-hours official test. At this test the combined efficiency on a non-inductive full load came out at 82¾ per cent., including excitation, and on one-third load the efficiency was 74 per cent. These percentages were reached with all the extra friction due to the plant being new, and will doubtless improve with continued use. Taking into account the high efficiency, the temperature of the hottest part, viz., 34° Fah. after six hours' run at more than full load, must be considered low.

The general design of the alternator has been briefly described, and seeing that the "low-efficiency" bogey put forward by many doubters and sceptics has been effectually laid there seems little reason to doubt that this form of machine will become widely popular among engineers. The mechanical quality cannot fail to appeal to the heads of central electricity stations, and when they are thus convinced that the coal bill will not be inflated by such introduction they will find it hard to resist the adoption of the inductor-alternator where the conditions of supply make its employment possible. First cost must, of course, be taken into account, and here, perhaps, the inductor does not hold the field and is not the cheapest type of alternator for a given output at a given speed. But its competitors increase rapidly in price if they have to fulfil equally stringent conditions in the direction of efficiency and regulations, so much so that finally the disadvantage of high price may be held to practically disappear. At all events, what remains of it will probably no more stop the adoption of the inductor-alternator than the higher cost of direct-coupled dynamos has prevented their adoption in preference to belt and rope driving. For some years back the Brush Company have been endeavouring to extend their works sufficiently fast to keep pace with the increased demand for their manufacture, and at present very large and important additions to the heavy machinery shops are being made in order to permit of an increased output.

We have spoken hitherto chiefly of the electrical portion of the Sheffield plant, but the steam portion of it—the engines—is little less remarkable. These engines are of the "Universal" type, which since their introduction a few years ago have been fast rising in favour. The Sheffield engines are, so far, the largest of this type that have been under steam (though several others will shortly follow), and have been as great a success as the alternators. Though to all appearance of the enclosed type, they can in a few moments be divested of their covering and become thereby as accessible as any open engine. Their extremely short steam ports render them highly economical of steam, and the fewness of the working parts ensures a corresponding economy in the way of repairs. Special attention has been given to secure easy and rapid adjustment of the heavy parts, which can be effected without the aid of a skilled mechanic. Each crank is operated by compound cylinders in tandem, each cylinder is single acting, and the two Corliss valves are between the cylinders, so that, as already stated, the shortest possible steam ports are obtained. The special construction makes the engine self draining, so that breakdown through water in the cylinder cannot occur. The steam consumption calculated from the diagrams was about 27¼ lbs. per K. W. hour at full load (allowing 10% for clearance), and is well within the specification. It is also particularly good on light loads. Each crankshaft has a bearing next the rotor 13 in. diameter by 34 in. long, the speed being 200 revolutions per minute. The proportions of the plant are thus so ample and its performance has proved so excellent, that the makers have raised its ratings from 600 to 750 K. W. capacity.

BRITISH LOCOMOTIVES FOR CHINA.

We have pleasure in illustrating herewith one or two types of railway locomotives recently constructed by the well-known firm of Dubs & Co. for the Imperial Chinese Railways. Considering the extensive publicity which has been associated with the ordering of some American locomotives for Chinese railways, it is somewhat refreshing to be assured that British locomotive builders appear to have been more occupied with work than self advertisement, and that they, to say the least of it, are holding their own in China. We are

FIG. 1.—EXPRESS LOCOMOTIVE, IMPERIAL CHINESE RAILWAYS. BUILT BY MESSRS. DUBS AND CO., GLASGOW.

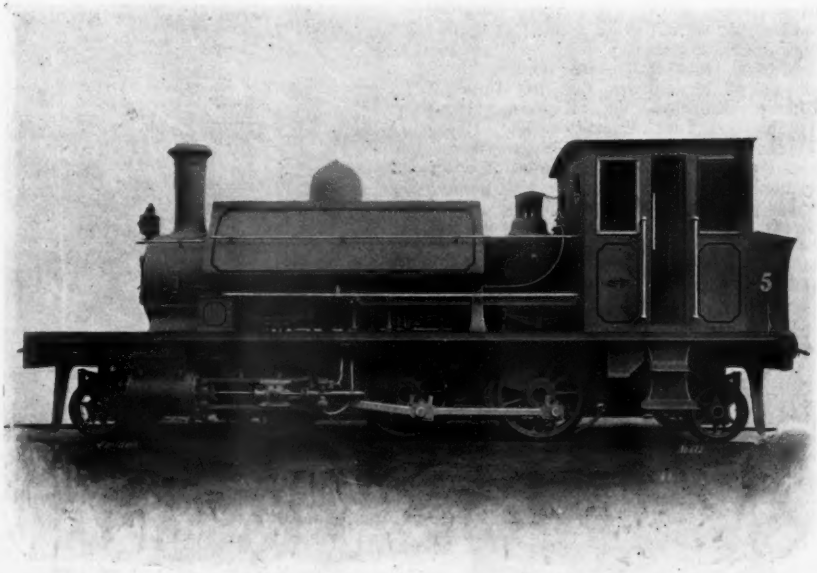
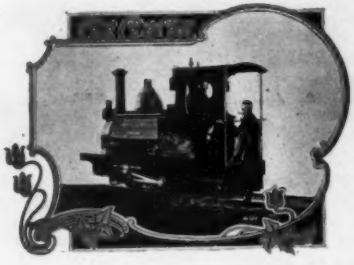


FIG. 2.—TANK LOCOMOTIVE, IMPERIAL CHINESE RAILWAYS. BUILT BY MESSRS. DUBS AND CO., GLASGOW.

informed, indeed, that the Baldwin locomotives are not considered to realise the expectations held out in connection with them ; and as this is stated to be the opinion of Mr. C. W. Kinder, the Locomotive Engineer to the Imperial Chinese Railways, who is not to be suspected of any personal bias in the matter, we can only conclude that the Philadelphia firms have not quite correctly gauged the conditions necessary for complete success in Chinese railway traffic.

Our illustrations show respectively (Fig. 1) a type of express locomotive which presents a curious unison of American and British practice, and (Fig. 2) a tank locomotive. All the engines supplied by Messrs. Dubs & Co. indeed, have outside cylinders with valve chests on the top, but otherwise, with the exception of being fitted with cow-catchers and pumps, and the firebox being constructed of steel instead of copper plates, the engines conform generally to British practice. The dimensions of the Express locomotive are as follows :—Cylinders 17 in. diameter and 24-in. stroke ; wheels, 5 ft. 10 in. ; heating surface, 1058·24 sq. ft. ; grate area, 17·17 sq. ft. ; weight in working order, 37 tons 16 cwts. The tank engine illustrated in Fig. 2 has cylinders 16 in. diameter and 24-in. stroke ; wheels 4 ft. diameter ; heating surface, 967 sq. ft. ; grate area 17·23 sq. ft. ; and weight, 52 tons 19 cwts.

Messrs. Dubs & Co. are sending three classes of locomotives for the Imperial Chinese Railways, viz., Express, Mixed Traffic, and Tank Engines. The Mixed Traffic Engine has proved very successful, and Messrs. Dubs & Co. have now on order a number of the same class with greater boiler power and special features suggested by Mr. Kinder. The "tail-piece" at the end of this article depicts the "Flying Victory," built by Messrs. Dubs & Co. for China in 1886.



VICKERS-MAXIM 12-INCH GUN.

THIS new gun, whose remarkable qualities have excited so much attention in this country and abroad, and which is now being introduced into the British navy, is of steel and wire-wound construction, 41 ft. 4 in.

OUTLINE OF THE "VICKERS-MAXIM" 12-INCH GUN.

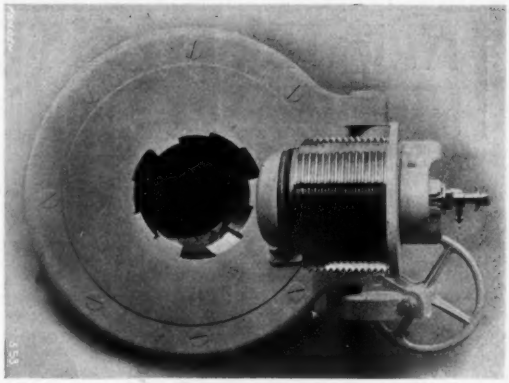
long over all, weighing 50 tons. It is capable of firing an 850-lb. projectile with a muzzle velocity of 2,612 ft. per second, and will throw this projectile a distance of eight miles. The energy of the projectile as it leaves the muzzle is 40,220 foot tons.

The breech mechanism is shown in the drawings : Fig. 1 showing the mechanism closed and locked ready for firing, and Fig. 2 the mechanism swung open, with the gun ready for loading. This mechanism, which is a patent of Messrs. Vickers, Sons, & Maxim,

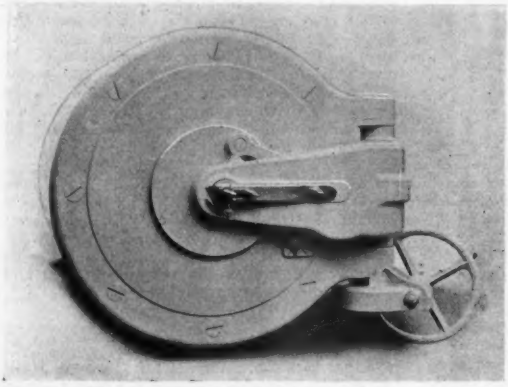
is worked by a hand-wheel ; by turning this wheel the breech plug is first unlocked and then the whole mechanism is swung out of the gun, all in one continuous action.

While the breech plug is being unlocked the firing gear is actuated by the mechanism and automatically ejects the fired primer, leaving the firing mechanism open, so that a new primer can be inserted while the gun is being loaded.

The breech mechanism is constructed so that it is impossible to fire the gun unless it is absolutely locked. It is of very simple design, easily taken to pieces and put together again, and can be worked very easily by one man.



"VICKERS-MAXIM" 12-INCH GUN : BREECH SWUNG OPEN.



"VICKERS-MAXIM" 12-INCH GUN : BREECH CLOSED AND LOCKED.

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IF you want a splendid Case to bind up your issues of the First Volume of FEILDEN'S MAGAZINE communicate with our Publishing Department without delay, when prices and particulars of Half-Roan and Cloth Cases, handsomely designed in green and gold, will be forwarded.

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ELABORATE ARRANGEMENTS...

are being made for increasing the already very large circulation of this Magazine during 1900. Our organization is being further strengthened all over the country and abroad. Firms not already having announcements in FEILDEN'S MAGAZINE are informed that owing to the rapidly rising sale of the Magazine, its consequent enhanced prestige and influence, and increasing costliness, the present advertisement rates will not obtain after the 15th instant.

INDUSTRIAL PROGRESS

ENGINEERING NOTES AND COMMERCIAL INFORMATION FROM ALL SOURCES.

CIVIL AND MECHANICAL ENGINEERING.

Pneumatic Tools in British Dockyards.—It is stated that the British Admiralty are about to adopt pneumatic riveters and other tools driven by compressed air for use in Admiralty dockyards, on a large scale. United States manufacturers of such specialities are looking forward to orders, as they claim they make the best type of tool of this description. An article on pneumatic tools will be found elsewhere in this issue.

"Air Ships."—Every attempt at aviation hitherto has consisted in attempts to utilise the buoyancy of the air. The validity of this principle, however, must be considered very doubtful. What depends for its support on the buoyancy of the air must be at the mercy of any disturbance of the air, and no stability can be looked for excepting in a calm atmosphere. Maxim and Langley, it is true, have departed in some degree from the balloon type; yet even they depended on the aëroplane, which is really only a modified balloon. In reference to this the Duke of Argyll, who has made no reputation worth speaking of as a mechanician, appears to have hit the point in a recent press communication on the subject. He says: "Nothing can be more certain than that no flying animal is constructed on this principle. Every one of them is constructed on the opposite principle of weight lifted and guided by mechanical energy. There is not a flying animal in the world, from the smallest midge to the largest bird like the condor, which is not always heavier than the air in which we stupidly describe it as 'floating.' If you wound the organs of mechanical energy every flying animal falls like a stone. I do not think that man can overcome the natural laws that condemn all buoyant bodies to an inertia that makes them useless. They must go with the medium in which they float. They cannot resist it, seeing that they have no fulcrum to act upon. My own belief has long been that if we ever are to navigate the air it must be on the mechanical principles which Nature has adopted in her glorious and exquisite mechanism of avian flight."

Utilisation of Waste Heat in Gas Engines.—It is pointed out that gas engineers reject from 20 to 50 per cent. of the heat supplied to them by allowing it to pass off with the water of the jacket. This is so far an unavoidable loss as regards the engine, but it need not be all loss. A gas engineer suggests that by means of a thermometer in the outlet of the jacket, the best temperature for each engine might be found approximately and adhered to. But even at the best there is still much waste heat, and he suggests it might often be used in the shape of hot water for the domestic supply. It may be used in radiators to warm houses, in public buildings for the same purpose, and so on. Yet gas engines driven by producer gas are as yet comparatively scarce, and millions are thrown away annually in waste gas, and waste heat of all descriptions, for lack of the means or spirit to utilise them. "We think," states a contemporary, "that many schemes for utilising waste heat might be inaugurated, were it not for the inevitable opposition of the local authority possessing streets to be crossed. A whole London square, for example, with a central garden, could easily be supplied with heat, water, and electric light and power from a comparatively small station."

American Locomotives for German Railways.—Considerable comment has been made on the Berlin Exchange in consequence of the introduction of American competition in the construction and supply of 20 compound locomotives required by the Saxon State Railway Administration. The Baldwin Locomotive Works, of Philadelphia, through their London representatives (Messrs. Sanders & Co.), offered to supply the engines for 54,760 marks each, delivered free at Chemnitz railway station, this price including the payment of customs duty and the cost of erecting the locomotive complete at that station, and shipment to take place seven months from receipt of the order. The lowest German tender for delivery at Chemnitz was submitted by the Breslau Works at 54,540 marks, or only slightly less than the American offer; but the time required for the completion of the engines was much longer, and the Baldwin Works have consequently been awarded the contract. Apart from other German firms, the Société Métallurgique,

of Brussels, entered the competition, but its price of 78,500 marks per locomotive exceeded even the highest tender sent in by any of the German works.

A Great Steam Superheating Plant.—The Aachen Mining Company have completed the most extensive superheating plant in the world in their works at Rothe Erde, Germany. All the boilers are provided with Schwoerer's superheaters, 42 of which have been installed in the flues connected with a similar number of Cornish double-flue boilers, having aggregate heating surfaces of 47,363 square feet. Besides these an additional set of five large superheaters of the same type have been connected with a second group of 24 Cornish boilers, with a heating area of 26,910 square feet. An interesting fact connected with this plant is the small loss of heat in the steam pipes used for conveying the steam to a distance. This loss is at the rate of only 1 deg. Cent. for each length of 42 ft. of 24-in. steam pipe, the total distance travelled by the steam being 1,050 ft. Very careful tests, extending over three years of day and night working, have shown the saving in fuel by the use of this plant to be from 15 to 20 per cent.

Bridge-Building Combination.—It is stated that a combination of bridge-building companies will be shortly concluded at New York. Negotiations are now being conducted between the syndicate managers and the Carnegie Company regarding a gigantic contract for structural steel to be made by the Carnegies and delivered to the combination which will be worth 10,000,000 dols. per year. The capital stock of the American company will be 67,500,000 dols., of which 29,000,000 dols. will be preferred cumulative stock, bearing 7 per cent. interest.

New Points in a Corliss Engine.—A steam engine has recently been devised which is claimed to possess some novel points. The engine is of the vertical compound type, arranged in general upon the Corliss lines. The cylinders are placed as closely together as possible, with all valves and steam passages between the cylinders, to avoid loss of heat from them and to facilitate the transfer of steam from one cylinder to the other, and for the sake of compactness. The first cylinder exhausts through passages directly into the second, the upstroke of the first coinciding with the downstroke of the second. The valves are placed as closely as possible to the interior of the cylinders, but there are only two to each cylinder, the steam and exhaust valve for each end being combined in one. All valves are actuated by one wrest plate, and such is the arrangement of the valves that the exhaust from the high-pressure cylinder immediately enters the low-pressure, the valve in the second cylinder being always open in time to permit its free passage. The work in each cylinder at normal load and pressure is exactly the same, and the weights of the reciprocating parts are balanced against each other by means of the pistons being cast hollow.

An Enormous Steel Plant.—The famous Duquesne Steel Works of Carnegie are to be still further enlarged, vast as are their present proportions. It is announced that the additions will embrace two blast-furnaces, each capable of producing 700 tons per day, fourteen 50-ton basic open-hearth furnaces at the Duquesne Works, and a reversible blooming mill at Duquesne, which is to work the ingots produced by the new open-hearth plant into billets and sheet bars. The estimated cost of these and other changes is computed at £1,200,000. To the British manufacturer the chief interest of this announcement lies in the confidence which such enterprise shows in the future of the American iron and steel industries. Already the Carnegie Company have resources for the production of over 2½ million tons of steel annually. Their new plant will probably enable them to increase this capacity to well over three million tons a year.

Benzine Motors for Canal Barges.—It is stated that benzine motors are being tried for driving canal barges in France, the first vessel of the type having recently been set to work on one of the canals connecting with the Rhine. This vessel is of the ordinary canal type, built of iron, but is fitted with a motor having two cylinders of sufficient capacity to give 12 horse-power. These operate twin propellers, both at the stern of the vessel, and the boat, which can carry 265 tons of cargo on a draught of 5 ft. 10 in., attains a speed considerably in excess of that with a horse on the towpath drawing the boat along.

An Electric Igniter for Gas Engines.—An igniter for gas engines has recently been devised, in which use is made of the well-known induction of electro-magnets to produce a spark or a succession of sparks of any desired length and temperature, thereby securing the prompt ignition of any charge, notwithstanding any probable cause of failure that may be able to affect the working of the usual igniters on the market, which depend on strength of current alone for the production of a single spark at the instant of breaking contact. The apparatus consists of a plug of sufficient length to screw into the cylinder or firing chamber. On top of this plug is mounted an electro-magnet, connected with an insulated post carrying a fixed electrode projecting beyond the bottom of the plug and tipped with platinum. The magnet core ends outside the plug, and is used to attract an armature on the end of a rocker arm, which also extends through the cylinder and carries the other platinum contact point. When the magnet is energised, the armature will be attached and the contact points separated, thus making a spark direct from the current. An instant later the induced spark from the electro-magnets follows. When the current is

broken the armature is retracted by a spring and the contact points close. The rocker arm is packed with powdered graphite, making a joint that is self-lubricating and gas-tight. A cam on the engine makes and breaks contact to operate the magnets, but the use of a magneto on the engine, and driven by it, is preferred, as it is cheaper, more positive than battery, and more easily kept in order, while the independence of ratio between spark and current allows the use of weak currents for heavy sparks. A shunt and push button allows the use of the igniter by hand when starting large engines.

Nickel Steel *v* Steel for Steam Boilers.—Nickel steel is coming into use as a substitute for ordinary mild steel in the manufacture of boiler tubes. Experiments have demonstrated that nickel steel of 20 or 25 per cent. of nickel will have, as regards acid corrosion, a vastly longer life than mild steel, and as regards deterioration from the action of heated gases and steam, at least twice the durability of mild steel. To manufacturers and others the growing importance of aluminium and nickel is a matter of much practical interest.

Cast Aluminium.—Cast aluminium is about equal in strength to cast-iron in tension, while under compression it is comparatively weak. With a purity of 99 per cent. the ultimate tensile strength of aluminium per square inch is, in castings, 18,000 pounds; in sheet, 24,000 pounds to 40,000 pounds; wire, 30,000 pounds to 55,000 pounds, and in bars, 28,000 pounds to 40,000 pounds. The elastic limit of aluminium of this purity is, for castings, 8,500 pounds; sheet, 12,500 pounds to 25,000 pounds; wire, 16,000 pounds to 33,000 pounds, and bars, 14,000 pounds to 23,000 pounds per square inch. Taking tensile strain in relation to weight, pure aluminium is as strong as steel of 80,000 pounds per square inch.

Two Tide Mills in France.—M. P. Renaud has described in the *Industrie* two mills turned by the tides in France. One of these, at Pont l'Abbé (Finisterre), is situated about 4 kilometres from the sea. A large pond behind the mill is connected with the sea by a river whose channel conducts the flow and ebb of the tide, besides serving for water-borne traffic. The tide passes up through clack-valves, which opening inwards dam back the ebb. As is known, the tides are worth about 12½ hours work per day. The distance between the mill and the sea makes the water take about 3 hours to get above the motors, and as these can go even when submerged, 14 hours work per day can be got out of them. There are ten pairs of stones, besides cleansing and bolting accessories. The power necessary is 80 horse. The effective fall during high tides is 2·50 m., and during low tides 2 metres average. This power has therefore to be got at both. There are two turbines, 70 horse each, with a 2·50 m. fall, or a total of 140 horse. The excess provides for 80 at any time, and also to let them run submerged when there is plenty of water. Working normally, the pond falls 0·45 m. to 0·50 m. in seven hours. Then the average quantity of water used per second is:—

$$Q = \frac{T \times 100}{H \times 0{\cdot}75}$$ the yield of the motors being 0·75.

T = 60 poucelets (3 poucelets = 4 horse power)

H = average 2·25 m.

$$Q = \frac{60 \times 100}{2{\cdot}25 \times 0{\cdot}75} = 3{,}550 \text{ litres.}$$

The volume spent in seven hours will be

$3\,m^4$, $550 \times 3{,}600^s \times 7 = 89{\cdot}460\,m^3$.

The superficies of the pond then must be

$$\frac{89{\cdot}460}{0{\cdot}50} = 178{\cdot}920\,m^2.$$ Say about 18 hectares.*

The average depth of the pond is 1 m. to 1·20 m., which ensures water in hand even at ebb tide. The motors used are two turbines with free vibration parallel rims and hollow vertical axles, and with Fontaine's conic water-feed regulator. These turbines are bevel-geared to a horizontal coupling shaft, which transmits their combined power again by conic gearing to a vertical shaft, which reaching to the top of the mill, drives the machines on every floor. The clack-valves are seven in number, and present a surface of about 9 square metres. The installation of the two motors with connections—excepting masonry—was about £1,000. Another such mill exists at Ploumanach, Cotes du Nord. It enjoys a fall of 4 to 5 metres. The pond area is about 1 hectare. The power represented by the 60,000 cubic metres accumulated by the sea falling 4 metres is 1,500 to 2,000 horse power per day.

* Hectare = 2 acres, 1 rood, 35 perches.

ELECTRICAL ENGINEERING.

An Electric Fire-engine.—An electrically-driven fire-engine is about to be tried in Paris. The hose-cart which will be used in connection with this engine has already been out on the public streets on trial runs, and weighs about a ton unloaded, and nearly 2½ tons with its full equipment. Of this weight the accumulators account for 1,140 lb. It is estimated that the hose-cart has a range of 37 miles on ordinary roads, with an average speed of 10 miles per hour. Of course with the hose-cart electrical energy is only required for moving the same on the streets, whereas with the fire-engine constructed on the same principle sufficient stored energy would have to be provided to drive the pumps after the engine has arrived at the seat of the fire.

Novel Electrical Omnibus.—An electrical omnibus with some novel features has recently been put on the streets of Berlin. It carries 21 persons and weighs, with batteries and passengers, 6½ tons, of which the accumulators only weigh 1½ ton. Two motors are used on each axle, making four in all. These are so arranged that the wheels are driven independently. The motors drive by

means of single-reduction gearing with a ratio of 1 to 7·5 on the front wheels and 1 to 8 on the back. The regulation is effected by means of series-parallel controllers in the usual way. The most important feature of the omnibus, perhaps, is its provision with a collecting bow, so that a charge of electricity can be taken from the overhead wires of the tramway company.

A Russian Electrical Company.—Messrs. Schuckert & Co., of Nuremburg, Germany, are, it is reported, promoting a separate company to carry on the Russian business of the concern. Negotiations are in hand with the view of converting the horse tramways in the town of Kischineff into electrical lines.

New Method of Accumulator Construction.—A new method of making electrical accumulators resembles that used in the original Volta pile, the cells being piled one above the other instead of being contained in separate glass boxes as is now usual. The battery consists of a series of shallow rectangular lead vessels with sloping sides, placed one above the other, with spherical insulators in the four corners of each vessel to prevent metallic contact. The bottom of each vessel is corrugated, the number of corrugations depending on the number of plates to be used in each cell. From the crests of the corrugations project inwards the negative plates, while the positive plates are suspended from the lower or outer face of the corrugated bottom. When the vessels are in position the downwardly projecting positives of any cell come between the upwardly projecting negatives of the vessel immediately below it. The vessels being shallow, the depth of the electrodes is comparatively small, hence the danger of buckling and short-circuiting is greatly reduced, and the fact that the cells cannot be readily inspected is not a serious disadvantage. The main advantages claimed by the author are: (1) a saving of floor space amounting to as much as 75 per cent. over the ordinary method; (2) there are no joints to be made between the terminals of consecutive cells; (3) absence of special containing vessels or boxes for the plates and acid, and better insulation.

Electric Locomotive for the Jungfrau.—The electric locomotive constructed by Brown, Boveri Co., destined for the Jungfrau Mountain Railway, is said to be the most powerful rack-wheel machine hitherto constructed, and is designed to haul trains over the steepest portion of the road. The motors are placed under the passenger cars, whereby greater adhesion between the driving-wheels and rails is obtained. The car truck is provided with two bearing axles and two driving axles, the latter being situated between the former. Two motors, each of 125 h.-p., at 800 revolutions per minute, actuate the toothed wheels through the medium of duplicate gearing. If required, these motors are capable of working up to 300 h.-p. The driving current is conveyed overhead at a tension of 500 volts. The pivots of the toothed wheels are of aluminium-bronze, the teeth being of cast-steel.

New Electric Railway Signal.—A new electric signal recently invented for railroad crossings gives a series of signals that enables everybody to tell how close an approaching train may be. It is entirely automatic, and the first signal is given at cross-roads when the train is a mile and a half away, by ringing a bell and displaying a signal that a train will pass within three minutes. The next signal is given when the train is half a mile away. It is thought that this new device will prevent many accidents.

New Swiss Electric Railways.—The Swiss Federal Council has granted a concession for the construction of an electric railway from Loëche, on the Jura-Simplon Railway, to Loëche-les-Bains. The line will consist of two distinct parts, the first of which will connect the town of Loëche with the main line, and the second, which will be used for tourists, going to the health resort at Loëche-les-Bains. The first section is only a mile and a half long, but a grade of 53 per cent. will be encountered in this distance. The line up to Loëche-les-Bains is about five and a half miles long, and on this the maximum grade will be about 20 in 100. The electrical energy will be obtained from the River Dala. It is also proposed to construct an electric railway between Chiavenna (Lombardy) and Martinsbrück (Grisons). The line would be 114 kilometres long.

An Electric Sewing Machine.—An electrically-driven sewing machine of a new type has been invented in Germany. Unlike hitherto so-called electrically-driven sewing machines, this one is driven by the aid of an electric motor mounted on the axle. The machine consumes ·7 of an ampere at 110 volts, and makes 1,000 revolutions per minute. The armature contains a number of windings, grouped in twelve sections. The small motor is shunt-wound, and on the base of the sewing machine is fastened a small rheostat, which gives the machine a varying speed of from 180 to 1,800 revolutions per minute.

Electrolysis and Cast-Iron Pipes.—It is stated that cast-iron pipes are usually but little affected by electrolysis, since the coating of adherent moulding sand and tar protects them. In the ordinary soil an iron pipe submitted to electrolytic corrosion is covered with a layer of oxide, which is a poor conductor of electricity, so that, with a given pressure, the deeper the layer of rust the slower is the rate of corrosion. In the case of cast-iron pipes, at Drayton, Ohio, the surrounding soil seems to give a different reaction when a current passes through it. The tar appears

to give no protection whatever, and the surface of the pipe is changed into a soft black material resembling graphite, and easily cut with a knife. The chemical analysis of the pipes shows that the percentage of iron is greatly diminished while the percentage of carbon is more than doubled. The use of wooden pipes in districts covered by electric mains is recommended.

An Electric Fog Horn.—An electric fog horn has been invented by a Canadian electrical engineer. A naphtha engine supplies the motor power for a dynamo, which furnishes the electric current by means of which three pairs of electro-magnets operate half a dozen clappers, which strike against a large gong with the frequency of about 36,000 strokes to a minute, producing an almost continuous sound. Its effectiveness is enhanced by a mechanism on the principle of a megaphone, by means of which the sound is not only intensified, but thrown in the required direction. It is stated that the sound from a small model was heard a distance of two miles. A full-sized fog horn is to be sent to the British Columbia coast, where it will be installed and put in operation at once.

A New Carbide Furnace.—The disadvantages of the usual type of furnace when used for carbide production have been summarised as follows: 1. Loss of carbon dust with waste gases. 2. Loss of carbide by exposure to air in heated state. 3. Loss of heat in fused carbide. The improved Borchers' furnace consists of a smelting chamber with thin walls enclosed in a water-jacket. The finished block of carbide is left for several hours in the furnace, and the heat which it gives out is utilised for steam generation. By working a series of such furnaces at intervals of two hours or less, a constant supply of heat for steam generation can be obtained. The carbon required for the formation of carbide is supplied by the electrodes; and the lime is used in the form of lumps, not in a fine powder. When the necessary heat has been attained within the furnace, the lime around the electrodes unites with these to form carbide, and this latter flows away in the fused state. The size of the furnace and the charge of lime are so adjusted that the sides of the smelting chamber are always protected by a layer of unused lime from the action of the intense heat at the centre. The system can be used with either arc or resistance furnaces. Professor Borchers claims for these furnaces that by their use one-fourth of the power hitherto used in carbide production can be saved.

Electrical Plant for Greece.—A company has just been formed in Athens, to be known as the Greek Electrical Company, with a provisional capital of 5,000,000 drachmas. The leading spirit in the new undertaking is the Thomson-Houston Company, which already has a branch establishment in Athens, and the other founders include the Athens Bank and the Société Générale d'Enterprises. The object of the new company is not only to undertake electric lighting in Athens, the Piræus, Syra, Patras, and Kalama, but also to construct an electric tramway in Patras.

Storage Battery Canal Traction.—The Erie Canal Traction Company have decided to adopt the storage battery for its motive power. The method of operation is stated to be as follows:—An electric traction engine will run along the towpath of the canal. It will tow a canal boat filled with storage batteries of sufficient capacity to furnish current for the traction engine, and for a reasonable number of canal boats with cargoes towed behind the battery boat.

The Importation of Electrodes.—An order of unusual importance to the Niagara Falls electric plant is stated to have been placed with the Acheson Graphite Company in October last, when that company closed a contract with a European firm to furnish them with 96 tons of graphitised electrodes. Europe has never before imported carbon rods in any quantities from the United States, and this is said to be the largest order ever recorded in this field of business. The process, it will be recalled, is the discovery of E. G. Acheson, who is president of the Carborundum Company and also of the Acheson Graphite Company.

Important Forthcoming Electrical Installation in Sweden.—It is announced that the large Ljungan waterfall at Olby, Sweden, is about to be utilised for industrial purposes, and this has necessitated extensive and interesting works of various natures. A company was formed some time ago with a capital of 2,000,000 kroner, which bought the waterfall and the adjoining land, and in the beginning of last year the work was commenced. A canal was constructed to lead the river round the waterfall, above which a dam was built. The works-building is about 130 feet long, and the inside height is over 60 ft. The water is led from the canal into the turbine house through five pipes of 6 ft. diameter, and two of about 8 ft. diameter. In addition to these, there are several reserve pipes, which can be taken into use without much additional cost, should the erection of new industrial establishments make them desirable. The dynamos will be direct coupled to the turbines, and the electric power will be conveyed direct from there to the workshops. The water power, which can be made available without interfering with that part of the stream which must be left intact, amounts to some 12,000 horse-power. About half this power will be required for the two large factories: Olby Electrochemical Company, and Olby Calcium Carbide Company. The latter is situated on the east, and the buildings of the former on the west, side of the canal. The Olby Electrochemical Company will manufacture chloride of potash according to a new process.

RAILWAY WORK.

New Railway in Sweden.—The Swedish Government has granted a Government loan or bond for a new railway in the island of Gothland. The proposed line is to run from Slite to Roma, a distance of about 20 English miles. There ought to be a chance for British makers to supply the necessary rails and other material.

Contemplated Gigantic British Railway.—It is stated that a project that has lately been under consideration, is likely, before long, to receive more practical attention. The project consists of a railway that shall run from Alexandria to join the Indian railway system *viâ* Basra; from there through Burma to Kulong Ferry to join the Yangtse Valley.

An Euphrates Valley Railway.—It is stated that an English syndicate has secured the concession from the Sultan of Turkey to build a railroad through the Euphrates Valley to the Persian Gulf. The project of building a railroad from Constantinople to the Persian Gulf was broached many years ago by the late Ferdinand de Lesseps, but his attempts were in vain. England and Russia have both tried to obtain a similar privilege. At last Germany received permission to build a railroad from a port opposite Constantinople to Angora, and the Anatolian Railroad was the result. The extension of this railroad from Koniah, first to Bagdad and thence to Bassora on the Persian Gulf, has been a scheme of the German Emperor.

A Proposed Electrical Railway between Croydon and Brighton.—It is well known that one of the most lucrative railway traffics in the United Kingdom is that between London and Brighton, and it is stated that a Bill will be brought forward before Parliament for powers to construct an electric line from Croydon to Brighton in the next Session. Cheap fares and high speeds will, it is stated, be the main features of the new line, which, however, will encounter the most determined opposition from the powerful interests concerned in the present monopoly, on the attempt to bring the conception into practical being.

An Improved Tip Wagon.—An improved form of tip wagon has been patented by Messrs. Walter Griffiths and F. Hawker, of the Darlington Wagon and Engineering Company. The usual contractors' tip wagon shoots its contents from the end or the side only, but the new wagon is so constructed that it can shoot them in any direction. The upper portion of the wagon revolves on a pivot and runs on three wheels. When it is brought round to where it is required, pins are dropped into sockets underneath, and so the body is secured. The wagon is then tipped in the ordinary way.

Railway Construction in India.—The following railway surveys have been sanctioned by the Government of India during the coming cold weather:—The Dit-Kunch-Jalaun-Madhogarh, 55 miles, and the Dholpure-Bari, 20 miles, by the Indian Midland Railway Company; the Mozaffur-Dharmapuri, 16 miles, and the Salem-Shevaroy, 8 miles, by the Madras Railway; the Amritsar-Sarhali, 26 miles, the Malekwal-Lyallpur, 100 miles, the Allahabad-Fyzabad and the Ganges Bridge, 100 miles, and the Khandwa-Akola-Basim Nanded, 150 miles, by the Director of Railway Construction; the Mutla River, by the East Indian Railway; the Dacca State Railway extensions, 234 miles, by the Eastern Bengal State Railway; the Arsikere-Mangalore, by the Mysore Durbar; the Kalikiri-Royachoti, 32 miles, by the South Indian Railway; and the Henzada-Myaanoung, by the Burmah Railways.

A Railway Project in Sweden.—A most important project has been laid before the Swedish Government for the purpose of bringing the Siberian Railway into direct communication with the railway system of Sweden. According to this scheme, it is proposed to construct a line of railway northwards from Stockholm to Keppel Kurs, the most easterly point of Sweden opposite the Finnish coast. From Keppel Kurs powerful steam-ferries will afford communication with Hango, a port at the extreme south-west of Finland, and thus a direct route will be opened by which goods brought across European Russia from the Trans-Siberian Railway will have a new port of export for the English and American markets. Ice-breakers built on the model of the *Ermack* will, it is expected, be able to keep this new route open to navigation during the winter.

British Steel Rails for Valparaiso.—Messrs. Chas. Cammell & Co. have recently shipped 5,000 tons of steel rails for Valparaiso. This cargo was shipped in the new Sunderland built steamer *Isel Holme*. The steamer *Novembre* was loaded just before the date of this shipment with 5,000 tons of rails from the same works for New Orleans, and the *Greta Holme* took in 3,500 tons of rails for Montreal.

Air Pump Lubrication.—It is reported that experiments are being made by the Norfolk and Western Railroad Company in the United States, to determine whether economy cannot be effected in the use of lubricating oil. One plan that has been tried provides that the oil be taken directly to the steam chest on the top of the pump and discharged on top of the side valve, so that the pump will have a chance to use every drop of oil fed to it. Where a triple-feed lubricator is used the oil pipe can be coupled directly to the steam chest of the pump, and as this style of lubricator is fed by direct boiler pressure the feed will not vary when the governor shuts off the supply of

steam from the pump. It has been pointed out that many 9½-in. pumps use more oil from the lubricator to the steam than the area of the rubbing surfaces and the work done by the pump should require. Frequently the drip cock at the pipe connection from the governor to the pump leaks considerably, as the weight of the handle is liable to work it open at a time when it is not noticed by the engineer. The joints at the governor are not always tight, and with a governor that has been in service a long time it is not unusual to see oil escaping at the vent-hole in the body of the governor cylinder.

New Railway in Russia.—Russia contemplates the construction of a line of railway from Orenburg in south-eastern Russia, and north of the Kirghese Steppes, in a south-easterly direction to Tashkend, the chief town of Turkestan and the military head-quarters of Russian Central Asia. A leading engineer of Ways of Communications has already been ordered to make the preliminary survey for the projected line, which cannot fail to be of the very highest strategic importance. Its length will be probably about 1,200 miles.

Proposed Conversion of Bombay Tramways.—The Bombay Tramways Company has in use 187 open cars, made by the company in Bombay. It employs 1,150 horses, each of which travels on an average 13 miles daily. The rails are of the girder type, 30 ft. long and weighing 83 lbs. per yard. They are laid on teak-wood ties and bedded in concrete. The road was opened to traffic in 1874, and its present cost is estimated at about 35,000 rupees per mile of a single track. The total gross receipts of the road for the last financial year were £79,700, and the operation expenses during the same year were £51,500. There is now a movement to convert the road into an electric line, the company having applied to the Bombay Government to sanction the conversion. Electricity has but recently come into use in India, Madras being the only city where it is used on street railways as a motive power. It is to be trusted that British engineers are on the *qui vive*.

A Swiss Engineering Syndicate.—It is stated that a syndicate of American and European capitalists has been formed for the purpose of establishing in Switzerland immense locomotive and rolling-stock works capable of turning out annually 600 locomotives, 1,000 coaches for ordinary railways, 1,000 coaches for electric railways, and 10,000 signals, points, &c. The directors of the syndicate are Mr. G. Burnham, of the Baldwin Locomotive Works at Philadelphia, president; Mr. S. G. Brill, of Brill & Co., Philadelphia, vice-president; Mr. W. Siemens, of Siemens & Halske, Berlin, secretary; Mr. de Neuflize, director of the Paris-Lyons-Mediterranean Railway, treasurer; Mr. Camille Barbey, administrator of the Yverdon-Sainte-Croix Railway, general manager.

Forthcoming Tramway and Light Railway Exhibition.—Next year an exhibition will be held at the Agricultural Hall, Islington, devoted to tramways and light railways. The show will be open from June 30th to July 11th. For several years there has been an exhibition of tramway apparatus and appliances at the annual meetings of the American Street Railway Association; but the forthcoming show at the Agricultural Hall is said to be the first of the kind ever held in this country, or indeed in Europe.

Railway Construction in India.—The very energetic United States Consul in Calcutta transmits to his Government the following information which, although probably not new to British engineers, is instructive, as showing them the nature of the competition being exercised against them:—"The railway mileage remaining under construction or sanctioned in India on March 31, 1899, was 3,568 miles. Improvements are being made on the railways now open for traffic to which I would call the attention of our manufacturers of locomotives, bridges, steel rails, cars, and other railway supplies, as it has been demonstrated that they can compete successfully for contracts for such supplies. Last year 7,000 tons of steel rails were delivered in Calcutta from the United States, and now I am informed that the Baldwin Locomotive Works have a contract for ten freight engines for the Bengal State Railway, besides three or four passenger engines for the Bengal Central Railway, and that the Burma Railway, the Bombay-Baroda, and the Central India Railways also have made such purchases. To ascertain what supplies are required and when contracts will be let, our manufacturers should correspond with Sir A. M. Rendel & Son, consulting engineers, 8, Great George Street, Westminster, London, S.W., for Indian State railways, East Indian Railway, Bengal and North-Western Railway, Southern Mahratta Railway, and the Bengal Central Railway; and with Sir George B. Bruce, consulting engineer, 3, Victoria Street, London, S.W., for Great Indian Peninsular Railway, Indian Midland Railway, and South Indian Railway. They should correspond with the Director-General of Stores, India Office, London, with reference to contracts for supplies for the railways worked by the State."

The Oiling of Railroads.—Two cars have just been completed at the Concord (N.H.) shops of the Boston & Maine Railway for sprinkling the road-bed with oil. Two sprinkling trains will be operated at the same time, and it is the intention of the company to apply the process to about 300 miles of track this season. About 2,000 gallons of oil are used for each mile of single track, and the cost of making the first application, aside from the royalty, is about $80 per mile. The experiments with dustless road-bed heretofore carried out by this company have, it has been officially notified, given very pleasing results.

MARINE ENGINEERING AND SHIPBUILDING.

Proposed Great American Shipbuilding Yard.—A project is now being undertaken for building a great shipbuilding yard at Camden, on the Delaware River. The New York Shipbuilding Company, as the organisation behind the enterprise is called, has a frontage of 3,600 feet on the Delaware, and its tract extends well back landwards, embracing as many as 130 acres. The foundations for many of the immense shops have already been laid, and work upon them is expected to progress rapidly during the winter months. The company will have long piers, the most improved machinery and plant, and great quantities of iron, lumber and other material will be needed within a short time.

Torpedo Boat Construction in the United States.—The future of torpedo boat building in the United States is very bright. The most progressive men in the navy are in many instances in favour of the construction of this class of vessels, the utility of liquid fuel is being tested, and the degree of success which attends the introduction of the primciple of turbine propulsion in British torpedo boats will be closely watched. The controversy as to the most advantageous type of boiler for the generation of steam on torpedo boats is another problem which may be expected to work itself out within a few years. Thus we find the United States Navy ready to introduce innovations in torpedo boat practice, and at the same time prepared for a quick utilisation of anything meritorious in foreign discoveries.

The Increase of British Shipping.—According to the latest figures of the Board of Trade the total British and foreign vessels that entered the ports of the United Kingdom for the first nine months of the present year, in cargoes only, represented 27⅛ million tons, against 25¾ million tons for the corresponding period of 1898. The clearances for the first nine months of 1899 were over 32½ million tons, against 29 millions. Here we have evidence of an enormous advance in the extent of our carrying trade, which explains and justifies the great increase in our shipbuilding programme. More than 19 million tons of the entrances and 22 million tons of the clearances were British bottoms.

The Use of Compressed Air for Raising Sunken Vessels.—What is stated to be the first use of compressed air for raising stranded vessels has been instituted by the Atlantic Wrecking Co., of the United States. The invention concerned is that of Morelia Sardou, and by his method jets of water are forced by compressed air under and around the vessel until the foundation on which she rests is transformed into a liquid mass, through which tugs are to drag the steamer into deep water. Wreckers claim that the scheme is entirely feasible, and the experiment will be watched with considerable interest.

TEXTILE INDUSTRIES.

Bleaching Flax with Ozone.—A mixed process of bleaching flax by chlorine bleach and ozone is stated, after numerous trials, to have been successfully elaborated by Dr. O. Frolich, in collaboration with Messrs. Kefferstein, of Greiffenberg, at whose bleaching works the method is now in use, turning out about half a ton of flax per diem. In his experiments, Frolich ascertained that if employed by itself ozone attacks the fibre and renders it less supple; but when first bleached by chlorine, and treated by ozone in place of grassing, better results can be obtained than by the ordinary method. The action of chlorine and ozone respectively is mutually complementary, and it is found that by shortening the exposure and working by a succession of stages, the chlorine process prepares the flax fibre for the ozone treatment. An improved effect is obtained by moistening the fibre previous to the ozone treatment with weak hydrochloric acid, turpentine and ammonia, the result being to increase the degree of bleaching attained without injuring the material. On coming into contact with the turpentine ozone liberates dense white fumes, exerting a very powerful decolorising influence.

The process at present in use may be described as follows:—The tresses of flax are subjected to the same treatment with lyes, acids, and bleaching powders as in the old method, but the stage of grass bleaching is replaced by exposure in the ozone chamber. With this object the tresses are moistened with very dilute hydrochloric acid, turpentine, oil, or ammonia, and hung in a closed chamber (as in an ordinary drying flue), where they are exposed to the action of ozone for several (6—7) hours. On removal they are again treated with a weak chlorine bleach, and after a second passage in the ozone chamber will be three-quarter bleached. If they are required full bleached, they are passed through a large number of chlorine bleach baths, alternated with exposures in the ozonizing chamber. In whiteness and elasticity the flax thus treated is equal to grass-bleached goods. The cost is about the same as grass-bleaching, but the method presents the great advantage that the entire operation is performed under cover in the works, so that bleaching can be effected all the year round independently of the seasons. There is also a considerable saving of time, the work taking only two thirds as long as the ordinary process; and, therefore, bleachers are better able to make contracts for delivery at a given date, which has been difficult, if not impossible, hitherto.

Crimping Wool.—A German dyeing firm produce crimp effects on wool by using substances which only produce their effect on steaming. The best things to use are the sulphites or bisulphites of the alkalies or alkaline earths, sulphocyanides, a few very soluble chlorides, such as those of zinc or calcium, very concentrated solutions of tartaric or citric acid, and resorcin. No stretching is needed, and the steaming must be stopped the moment the required effect has been produced.

The following example is given. Print bleached wool with a mixture of one litre of tragacanth water and one kilo of calcium sulphocyanide. Then dry and steam for about a quarter of an hour under 7 lbs. pressure. Care must be taken that the steam has free access to every part of the material, and that there is nothing to hinder the contraction of the printed places. After steaming wash and dry. The same process can be applied either to dyed or undyed wool or wool mixtures. Dye can also be printed on at the same time as the mercerising agent.

Another New Textile.—In a U. S. Consular Report, Mr. Atwell writes from Roubaix:—Some years ago, an explorer in Asia discovered a plant of silken fibre, used by the Turcomans for the manufacture of withes and cord and by the Canagues for woven goods. This plant, known as the *Apocynum venetum*, is a sort of bush with slender cylindrical branches, sometimes 6 feet high. It grows in Europe, Siberia, Asia Minor, the North of India, Manchuria, and Japan; but it is not cultivated, and, up to the present, has been used only in the natural state. The branches die yearly, and in the spring new shoots start horizontally from the roots. Under favourable conditions, the *Apocynum* develops quickly, and in a short time the branches form a thick growth, almost like a miniature wood. The best fibre is obtained by cutting the branches in midsummer, when the plant has obtained its full growth. The attention of the Russian Government was called to this plant in 1891. It is there known as the *Apocynum sibericum*, because it was first seen in Siberia. It grows luxuriantly on the banks of the Amu Darya and the Ili, and the natives of these regions have used the fibre for many years for cord and fish nets. They value it not only for its great strength, but also because no care is required in its cultivation. In 1895 the Russian Government began to use it in the manufacture of bank-notes, and since then the plant has been cultivated at Poltava. The results obtained thus far are considered excellent, and the time is doubtless near when the *Apocynum venetum* will take an important place in the textile market.

MISCELLANEOUS.

New Waterworks at Tampico.—It is announced that a system of waterworks and sewage is to be put into construction in the city of Tampico, Mexico. English contractors should request information from H. M. Consul, by G. W. E. Griffith, in Tampico.

British Industrial Progress in Ceylon.—During the past year, trade in Ceylon has been very prosperous. A considerable development has been made in the trade of plumbago, which is the chief mining industry in the country. The mining, so it is stated, is not at present conducted on scientific principles, but it is anticipated this drawback will, before long, be corrected. The figures for exports and imports have risen from less than 84 to over 181 millions of rupees, and it is expected that this increase will be proportionately maintained in future.

Export of Agricultural Engines.—The value of the agricultural steam engines exported in September was £57,081, as compared with £62,459 in September, 1898, and £36,309 in September, 1897. In these totals European countries figured for £45,674, £44,798, and £29,012 respectively. The aggregate value of the exports to September 30 this year was £585,522, as compared with £527,470 in the corresponding period of 1898, and £439,149 in the corresponding period of 1897. In these totals European countries figured for £476,487, £479,319, and £347,928 respectively. The exports of 1897 were reduced by the great strike in the engineering trade.

Steam *v.* Water-Power in the Manufacture of Carbide.—An article recently appeared in a German contemporary comparing the prospects of steam and blast-furnace gas with waterfalls as sources of power for the production of carbide. The author states that in practice 3·68 kilos. of carbide can be produced per effective horse-power in twenty-four hours, and that therefore 272 effective horse-power is required at the electrodes of the furnace to produce 1,000 kilos. per twenty-four hours. Allowing for losses, and taking an efficiency of only 75 per cent. in the electrical plant, 450 horse-power would be needed to produce this. The cost by water-power would be 13,500 marks per annum, and from steam, with brown coal at 3 marks per metric ton, 21,294 marks, or with coal at 9 marks per ton, 23,340 marks. Carbide has, in one district where water-power was not obtainable, been produced by steam-power at the net cost of 176 marks per ton.

The Forthcoming Paris Exhibition.—More than a hundred congresses in different departments of science and art, covering pretty well the whole field of intellectual activity, have already been arranged to be held during the Paris Exhibition. An influential committee, of which Professor Patrick Geddes and Professor James Mavor are the joint secretaries, and which already includes names so famous as those of Sir Archibald Geikie and Lord Lister, Professors Schafer and Oliver Lodge and J. J. Thomson, Dr. John Murray, and Professor Sedgwick, with many others, has been formed as a nucleus for a general committee "consisting of members of the British Association, the Association Française, and of other representatives of pure and applied science, education, art, &c., with the object of promoting arrangements for an international meeting or assembly in connection with the Paris Exhibition of 1900."

Characteristic New York Architecture.—"Buildings," says a contemporary, "of twenty stories and upwards are becoming common in Broadway, New York, which will speedily exhibit the appearance of a crack in the masonry—like one of the 'wynds' of old Edinburgh—the height of the residential and office towers lining it having no reference to the width of the thoroughfare. It is considered by our contemporary that the cities of Europe—more especially of England—will have to make use of the same kind of building in order to accommodate the business that must be done within a limited area. The high building is a town in itself; only its tramroads run vertically instead of along streets. The system brings comfort and convenience up to the highest standard. Telephones fixed to every desk reduce to a minimum the necessary amount of running about. The lighting and heating of all the rooms and passages is done by plant installed on the premises. In short, while imaginative novelists everywhere have been indulging in flights of fancy as to what the character of the architecture of the coming century is to be like, in the United States the town of the immediate future is being realised as a city of towers. Babel, it appears, is coming into fashion again, with the advantages of electric hoists, lights, telephonic connection, and steam heating. There would not appear to be much room for gas in these towers, to judge from contemporary technical publications.

The Importation of American Brewery Plant.—An American contemporary states that the Pfaudler Vacuum Fermentation Company, of Rochester, N. Y., has received a contract from Samuel Allsopp & Sons, the English brewing company, for the equipment for breweries in Germany, Bavaria, France and other European countries. The contract is worth £30,000, and a part of the equipment has been forwarded to England. The Pfaudler Company recently erected plants in Heisingborg, Ystadt and Stockholm, Sweden; Christiania, Norway; Besançon, France; Viborg, Finland, and Warsaw, Poland. The South African Brewery, in Johannesburg, was of American construction, everything except the bricks being shipped from America. The whole contract was worth upwards of £100,000, and we are now adding to the plant. They are now arranging for the construction of a £401,000 brewery in Cape Town. The machinery will cost about half that amount. The Sydney brewery cost £30,000.

British Trade in Guiana.—Now that the Venezuelan question is definitely settled, the attention of British capitalists and manufacturers might be profitably directed to this promising but undeveloped British Colony. The country, it is stated, is as beautiful there as elsewhere in tropical America. But the chief hope of profitable exploitation of the interior is founded on the extraction of what lies within the soil rather than on what may be grown. Quartz is found in many places. In the upper waters of the Essequibo and its tributaries large masses occur. It abounds in all the mountainous regions, and reefs of it lie in the savannahs. Nearly all the rivers and creeks are gold-bearing. From one end of the Colony to the other, according to a report of the Government Mineralogist, gold is found, disseminated in lumps and grains and fine dust in the banks and beds of the streams. Alike in the Barima district—reserved to Great Britain, only the Point passing to Venezuela—in the Cuyuni, and in the Essequibo there is quartz of undoubted richness. In many of the gold placers diamonds and white sapphires have been picked up. "There is not the slightest doubt," says an official report, "that diamonds are to be found in the different rivers of the Colony." Dry mines may yet be worked. It is expected that valuable shallow diggings will be discovered in the neighbourhood of the Mazaruni. Coloured diamonds—"perfect, glassy, octohedron stones of the best quality"—have been brought to light. Guiana may yet have a future as a diamond-producing country. For the present, however, hopes of prosperity must be centred upon the gold industry. The yield for 1897-98 was 121,490 ozs., mostly from placers. Three small companies had erected quartz-crushing machinery, and produced in the previous year 6,458 ozs. of gold. In 1884 the gold obtained from placer mining, which was alone carried on until 1896, was 250 ozs. In 1889-90 it was 32,332 ozs., and in 1890-91, 66,864 ozs. There can be no doubt that gold is to be had in paying quantities in considerable areas in many parts of the colony.

Wood-Pulp from Canada.—The Canadian wood-pulp industry, large as it is at present, seems likely in the near future to develop to an enormous extent. The largest shipment that has ever crossed the sea, viz., 4,700 tons, was landed recently for the English market. Large shipments also are being continually made to Japan.

British Electrical Plant in the Far East.—The following observations from an American, Professor F. B. Crocker, who has recently returned from a journey round the world, by way of Japan, China, the Philippines, and India, are interesting to British manufacturers. The professor found that in China and India British electrical plants were being installed, and he declares that in the Far East the superiority of the States manufacturer is not yet recognised, so that evidently British enterprise has the ball at its feet if it will but kick it. Professor Crocker says: "Beyond question those countries are on the eve of great development in electrical applications. Electric railways will certainly be introduced very widely. The Oriental is exceedingly fond of travelling, as shown by the crowds of natives upon Indian and Japanese railways and the fact that these railways are financially successful. Electric power transmission systems will also be installed in many places. Water-power is quite abundant in Japan, China, and certain parts

of India, and is destined to play an important part in the opening up of these countries. Electric lighting plants are just beginning to be put in. For example, the first central station in Calcutta was erected during the present year, although that city is the metropolis of India with nearly a million inhabitants. There are few places in the world where the electric light is more desirable than in Calcutta, the climate being excessively hot during the greater part of the year."

The Use of Water-Softening Plant.—We learn that Messrs. Mather & Platt, Ltd., are receiving many enquiries for their Water-Softening Apparatus, and have on hand, amongst others, the following installations:—The Cannock and Rugeley Collieries, Hednesford, a plant for the treatment of 6,000 gallons per hour; Seaham Harbour Collieries, Sunderland, for the treatment of 6,000 gallons per hour; Whitechapel Electrical Works, for 3,000 gallons per hour; the Rand Mines, a plant for 1,000 gallons per hour.

A Good Fountain Pen.—The "Standard" Fountain Pen, which has been brought to our notice, possesses the special features which distinguish a good fountain pen from a bad one. The "Standard" does not leak, has a double feed, and a fourteen-carat nib, tipped with iridium, and is furnished with points to suit all styles of penmanship. The "Standard" pen is manufactured by the American Stationery Company of Nicholas Street, Bristol.

A New Celluloid.—In reference to our note in last issue under this reference, Mr. Bernard E. Jones, 85, Brighton Road, Redhill, Surrey, writes:—"On p. 505 of your November number, acetate of cellulose is described as a 'new celluloid.' May I venture to, in part, correct this? Acetate of cellulose has been known since 1894, when its manufacture and composition were made the subject of a British patent, granted to Messrs. Cross and Bevan. The process of manufacture as described in the patent specification (No. 9,676, 1894) is condensed here for the benefit of your readers. Equal parts of dehydrated cellulose and a concentrated solution of zinc acetate are mixed together and dried at a temperature of 110° Centigrade. After powdering, it is mixed a little at a time with acetyl chloride, two parts of the latter being used for every one part of zinc acetate previously used. After well stirring, the temperature in the meanwhile not being allowed to rise above 30° Centigrade, the reaction will be completed, and the mass is then washed with water and dried. This washing removes the zinc salts. To free it from unconverted cellulose, the mass is treated with chloroform, which dissolves the acetate of cellulose. The solution is filtered, and the chloroform is driven off by heat, the acetate being left in the form of a transparent film.

Lord Charles Beresford and British Machinery in China.—In a recent speech, Lord Charles Beresford declared that he had seen in China British machinery and plant, with the name-plates of the makers removed and others bearing the names of German engineering firms substituted for them. Upon enquiry of two firms mentioned, Messrs. Sir W. G. Armstrong, Whitworth & Co., Ltd., and Messrs. Greenwood & Batley, Ltd., we find that Messrs. Sir W. G. Armstrong, Whitworth & Co., Ltd., are inclined to doubt the correctness of Lord Charles Beresford's statement so far as their Whitworth machines are concerned, the names, as they point out, being cast into the bed-plate, and consequently very difficult to obliterate without detection. On the other hand, Messrs. Greenwood & Batley, Ltd., inform us they have supplied German firms with machinery intended for China, but that they have no direct knowledge of the substitution referred to. We refer to the matter at greater length in our editorial columns.

Important Marine Water Tube Installation.—We learn that an important step has been taken by Messrs. Thomas Wilson & Co., Ltd., well known in connection with the "Wilson" Line of steamers, in fitting one of their large passenger boats—the ss. *Maretillo*, employed on their Hull to New York and Boston service, with four of the largest size marine type water-tube boilers of the Babcock-Willcox Boiler Co. The importance of this contract may be appreciated from the fact that, during the last seven years, Messrs. Wilson & Co. have been gradually adopting the Babcock-Willcox system in their Continental boats, commencing with the *Nero* in 1892, and finishing with the *Tasso* in the beginning of the present year, the latter making the eighth in number of these vessels fitted with the Babcock-Willcox water-tube boilers. The result of the seven years' experience has been so satisfactory that the Wilson Line now feel quite justified in extending the use of water-tube boilers to their larger vessels running to America. The Babcock-Willcox water-tube boiler has been so successful for land service that it has become, to a large extent, identified in the public mind with factory power. It will be a surprise to many of our readers to learn that it has been adopted in H.M. Service, the torpedo gunboat *Sheldrake* being fitted with four Babcock-Willcox water-tube boilers in February this year. The trials, amounting to runs extending to some 9,000 miles at various rates of steaming, have been found so satisfactory that another order has been received from the Admiralty to equip the Babcock-Willcox boilers in the new warship, H.M.S. *Espiègle*, which is now being done. Within the last month alone, Messrs. Babcock & Willcox have received orders for a large number of their boilers for marine service, particularly the sand dredgers for the Queensland, New South Wales, and Indian Governments, the dredgers themselves being built by Messrs. Sir W. G. Armstrong, Whitworth & Co., Ltd.; also water-tube boilers for steamships trading to Odessa, built by the Société Anonyme John Cockerill, Hoboken.

BRITISH.

Engineering: October 13th, 1899.

American Competition. IV.
The British Association.
The Design of Rotary Converters.
Messrs. Loewe's Machine-Tool Works.
Messrs. Schneider & Co's. Works at Creusot.
Armour-Plate Planing Machines.
The Bacterial Treatment of Crude Sewage.
The Action of Heat on Indiarubber.
New American Trusts.
American Iron Supplies.
The Oriental and Graving Dock, Shanghai.
Magnetic Ore Separators.

The interesting articles on American competition are continued in this issue, the present contribution, one of the best in the series, being anonymous, but, as stated, from a well-known English engineer. We make the following extracts :—

> In America the owner or manager of a shop does not rest satisfied, but is always on the look-out for improved methods whereby the work can be done more quickly, and of course as well. The result of this constant striving to do better things, mechanically speaking, is that machine tools are regarded as temporary, not permanent, means to an end. In no first-class American works is obsolete machinery to be found. It is often the rule to regard eight years as the full life of a machine ; at the end of that time it is expected to be out of date, and must be replaced by another more efficient ; depreciation charges in shop accounts are charged on this basis. The result of this constant striving after better things is to stimulate master and man alike, keeping the former keenly on the look out for improved processes, and encouraging the latter to devise new methods for increasing and bettering output. Constant changes are thus in progress, and probably experience has taught the American manufacturer seldom to make a mistake when he makes a change.
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> The United States has a far greater home market than Great Britain ; its customers have become accustomed to certain fixed lines of products. American manufacturers can therefore standardise and reproduce in great quantities more easily than we. In foreign markets America is, at least, in one respect, on a far better footing than ourselves. The very low through freight rates that it is possible to obtain in America, owing to the combination of railway, dock, and shipping interests, greatly affect the question. Rates per ton are cheaper between, say, Chicago or St. Louis, and any English or Continental town, 4,000 to 5,000 miles away, than between English or Continental towns separated by but a few hundred miles. British railway freights are ruinous.
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> . . . Nearly all large English concerns are managed and controlled by elderly men—men doubtless of great capacity, but who naturally are unwilling to try new methods with which they are unacquainted. In America the reverse is usually the case.
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> A vital point in which we are far inferior to America is our technical colleges. These are certainly better than they were, but they still leave much to be desired. The narrow-minded policy of trade unions existing in this country is also a fertile source of trouble. It is a fact that a very large number of skilled foremen in those American workshops which are inundating the world with their products were originally British subjects. In America the harder a man works the better he is paid, and there is little time or inclination for loafing. Great encouragement is also given to the inventiveness of the men. We find English, Scotch, Irish, Welshmen, Danes, Norwegians, Swedes, Germans, and Swiss throughout America occupying high positions. They have become naturalised, and in many cases are more American than the Americans. They bring to bear upon the conditions that exist the special knowledge which they have brought with them from their former homes.
>
> . . . American engineers and managers may now be found the world over, studying the requirements of different countries. They try to impress foreign customers with the superiority of their goods, and send home most elaborate and valuable reports. They will manufacture exactly such goods as the special market may require, instead of forcing standard lines of products on those markets.

Engineering contains a useful editorial on "The Industrial Use of Alcohol," whose sale for industrial purposes is so greatly restricted through the state of the law in this country.

> In Germany, says *Engineering*, "denatured alcohol," *i.e.*, spirit rendered unfit for consumption as a beverage, is sold absolutely without restriction, as, though a licence to sell is required, this is never withheld from anyone who has not been convicted of evading the Excise laws, and further the salesman is not bound to register the quantities or destination of the spirit he supplies. The process of denaturising the alcohol can be done anywhere on application being made to the proper authorities, though not less than 1 hectolitre can be treated at a time. On notice given, two Excise agents attend, the sealed bottle of denaturant supplied by the authorities is then opened by them and added in their presence to the spirit to be treated. This done, the spirit can then be sold freely without the least restriction. The official denaturant consists of four parts methylene and one part of pyridic bases extracted from coal tar, 2.5 litres of this mixture being added to every hectolitre of pure spirit. The total cost of denaturisation therefore, including the travelling expenses of the Excise agents, does not generally exceed ½d. to 1d. per litre, and the spirit is in consequence commonly retailed at 5d. per litre in Berlin (about 5½d. per quart). Further, when the use of the official denaturant renders the alcohol unsuited for particular manufacturing purposes, every facility is given for the substitution of other adulterants, these being chosen with special reference to the particular application of the spirit. Such spirit is, however, subject to restrictions as to sale, and the maker must register all transactions in it. Any contravention of these Excise laws is fined exceedingly heavily—as much as 500*l.*, in addition to quadruple duty—and a second offence involves imprisonment. Even when the lapse is accidental, the penalty of quadruple duty is rigorously enforced. In this way the authorities succeed in preventing fraud whilst giving every facility to honest users. The consumption, therefore, is exceedingly large, reaching 867,488 hectolitres (19,123,000 gallons) in 1896-7, of which about two-thirds were used for heating, lighting, and motive power.

Engineering: October 20th, 1899.

American Competition. V.
Our Annual Fire Loss.
Maschinenfabrik Oerlikon.
A Model Tramway Station.
Messrs. Schneider & Co's. Works at Creusot.
The Waverley Station, Edinburgh.
The Japanese Battleship "Shikishima."
Imperial Chinese Railways.
The Manufacture of Liquefied Carbonic Acid.
Sound Locator and Projector.
Magnetic Ore Separators.
Expansion Gland for Steam Pipes.
Similar Structures and Machines.

The articles on "American Competition" are remarkably free from repetition, considering the subject. In this number of our contemporary there is a very out-spoken contribution by an American engineer. Its general tenor may be judged by the following extract:—

> The position, as a manufacturing nation, of Great Britain is that derived from dear-bought and long-time developed experience. May it not be accepted as an axiom that that which is obtained slowly and by arduous effort will be the longer cherished and retained? Experience is the most valuable asset of civilisation. It is also, too frequently, the greatest bar to progress. Pig-headedness, obtuseness, and stupidity, are often excused on the plea of "experience." It is mainly from too firmly anchored opinions which have sprung "that conservatism which fights all innovations, simply because they contravene present ideas and practices, and against which advancement must ever contend." On the other hand, the relatively high place occupied by the United States, in all except the heaviest classes of machinery, forgings, &c., has resulted, to a considerable degree, from successful experimentation; the consequence being a greater and better output in less time, or with less labour, than is possible by old methods. It is confidently asserted, as a fact of common knowledge, that the necessity, or the desire, or the spirit, which conceives the vision of an improvement in process or method, and then promptly carries it through to a successful practical demonstration, is the most likely to be eager and ready to improve upon the improvement if the opportunity is presented. "Every undertaking, properly executed (should) bring about improvements in the process of execution."

From an interesting article on Imperial Chinese railways we take the following respecting Chinese labour characteristics.

> The Chinaman has little of the consuming energy of the American, or the steady application of the German, or the sense of duty of the Englishman. Of course I do not assume the worst characteristics of either race. When he is paid by time, he does not work more than he can help. When he is on piece-work, his affection for the almighty dollar, developed in his race to the highest degree, makes it his tendency to scamp his work, and very ingenious indeed can be his devices in this direction. Running a machine tool would seem therefore to be work wherein he would be most effective, but even then he wants a smart shop foreman, not of his own race, to see that tools are running at an effective speed and cutters held up to their work. Probably as time goes on, and his standard of comfort increases, so also will his wages have to rise, as well as his efficiency. What can certainly be said at present is that it takes more of him to do an equal amount of work in a given time as compared with the European. . . . This overplus of labour and infinitesimal coinage is responsible also for the terrible amount of theft of small loose parts, or even fixed parts, of the loose or fixed plant on the railways. Where articles of brass or copper are worth to Chinese what they might be were they of gold in England, and iron and steel equal to copper with us, one cannot wonder at the pilferage that goes on!
>
> Keys are withdrawn, nuts unscrewed, bolts taken out on every possible opportunity, and perhaps no small extent of the repairs which are a little too much *en evidence*, is due to the wilful removal of some small part causing damage or accident. Brake gear and the centre-pins of Janney couplers are favourite objects of removal, for there is a just discrimination as to what is of superior quality, when purloining such "unconsidered trifles." It is very characteristic, too, of the people how callous they are to the risks to others, and even to themselves, which such practices entail.

Mr. Grant Powell's estimate of the comparative merits of English and American made locomotive engines on Chinese railways will be read with interest. He says:—

> Turning to the much-vexed question of the English and American engine, experience in China would seem to prove that while the English engine is superior in workmanship, the American engine has much which is ingenious and satisfactory in design, though often marred by inferior material and workmanship. In coal consumption there is no doubt whatever as to the advantage of the English engines. The latter hauling a certain load at the same speed burn about 50 lb. of coal per mile. The Baldwins for the same load and speed burn fr m 80 lb. to 100 lb. The saving in fuel of the English engine is often attributed by Americans to greater care in stoking; but in this instance, at all events, where both are treated on the same footing, the result does not seem to be so caused; and the same argument applies in Japan, where the excessive coal consumption tells against the American type. Fittings of United States engines are bad, such as water gauges, injectors, cocks, and clacks, &c.

Engineering: October 27th, 1899.

American Competition. VI.
Messrs. Schneider & Co.'s Works.
The Design of Rotary Converters.
Machine-Tool Works of Messrs. Ludwig Loewe & Co.
Heavy Duplex Lathe.
Automatic Generator for Acetylene Gas.
Tests of an Electric Railway Power Plant.
Ortman's Evaporator.
The Deceptive Fracture of Pig Iron.
Similar Structures and Machines.

The contribution on "American Competition" in this issue of *Engineering* is by Mr. G. N. Barnes, Secretary of the Amalgamated Society of Engineers. Mr. Barnes propounds his remedy in terms which we frankly acknowledge are not very clear to us. However, here are his own words:—

> *Conclusion.*—To sum up: I should say, that we, as British engineers, will best set our house in order, not by slavishly imitating America, but by adapting ourselves to, and harmonising our methods with, our own general social environment. Freedom of contract—that is, each for himself, the devil taking the last—may be just possible in the United States for some time yet, with the assistance of a doctor per 606 of the population—we have 1 per 1,717—the Germans 1 per 3,038. In this country we have got beyond it, never to return; and a general and frank recognition of this fact would do much to establish that mutual respect and fair dealing between employer and employed, in the absence of which permanently good results are impossible. It is foolish to decry trades unions. For good or ill, unions are here and will stay. The sense of unity among workmen will not diminish; and for my part I am not at all alarmed by the fact that employers are also organising. Greater facilities may thereby be afforded for applying the common sense of the trade as a whole for the prevention of abuses. It

is equally foolish to rail either at the one side or the other, in regard to the non-introduction of machinery. Whoever is responsible, the point to be kept in mind is, that machinery and workshops of the latest and most approved type are absolutely necessary, and should be honestly used. And last, though not least, hours of labour should be reduced, and facilities afforded for mental as well as physical development: for the all-round training of apprentices and men in the theory as well as practice of their calling. It may be necessary, under competitive conditions of industry, to keep a man pretty much confined to one operation or one set of operations; but he will be a more efficient, because a more interested worker in his special sphere, if he has a knowledge of the relation of that to other spheres of activity.

Engineering: November 3rd, 1899.

American Competition. VII.
The Waterways of Russia.
The Paris Exhibition of 1900.
Removing Railway Bridges, L. & S. W. Railway.
Great Central Railway.
Engineering Works of Escher Wyss & Co.
Engineering Works of China.
Four-Wheel Coupled Express for the Vandalia Railway.
Incrustation of Pipes at Torquay Water Works.

"American Competition" still forms the weekly *pièce de resistance* in *Engineering*, and it is becoming evident that the articles on the subject are attracting wide attention. The contribution to this issue is made by Mr. Oberlin Smith, a well-known writer on technical subjects in the United States. We give two extracts from his article; the opening words of the first are worth noting:

> In the matter of producing machines, wherein that class of Englishmen called Americans, appear to have acquired a peculiar skill, the chief element of low cost does not seem to be due, to much extent, to cheapness of materials, and probably not in any very great degree to superior average intelligence among journeymen workmen; although it is doubtless probable that the long established public-school system of America has produced a higher average grade of education among this class of the population.
>
> In a general view of this subject too much importance should not be attributed to certain quite recent importations to Great Britain and her Colonies of heavy articles, such as locomotives and bridges, as in some of these cases American cheapness and quickness has been aided by local and temporary conditions which have caused British manufacturers to be unusually busy, and consequently behindhand with their orders. As far as we can judge from this side of the water, such conditions have been partly brought about by the recent great strikes, the like of which it is to be hoped will not soon happen again, and which may not be a permanent factor in the question at issue.
>
> Returning to the consideration of comparatively small mechanical productions (it must be remembered that in big things like ships Englishmen are still taking the lead), such as watches, clocks, pistols, guns, sewing-machines, agricultural implements, flour-mill machinery, and machine tools of all sorts, such as drillers, millers, lathes, shapers, planers, automatic screw machines, punching, cutting, and drawing presses for sheet metals, etc., there doubtless is, and probably will continue to be, a considerable volume of importation from America. The principal reason for this undoubtedly lies in a certain mechanical habit which this generation of Americans has partly acquired and partly inherited, which leads to a radically novel method and system in a great many manufacturing operations. Whatever inherent merits this general system may possess will doubtless lead to its gradual adoption by so intelligent and highly-trained a class as British engineers and manufacturers. In thus absorbing, so to speak, some mechanical Americanisms, reciprocating certain absorptions of English ideas, which Americans have duly indulged in, British engineers will find that it does not pay, as has perhaps been too often the case with cars, locomotives, bridges, etc., to design each particular article, or set of articles, individually, regardless of the designs of other engineers in similar lines. The very proper pride in some individual design which leads an engineer to put it before the world as a work of art, as does a great author, painter, or sculptor the product of his brains, is not adapted to meet modern industrial competition, where the works in question must be cheaply produced for the full enjoyment of the public at large. . . .
>
> Another element in the cheapness of American machinery may sometimes be found in its simplicity, compared with European, and especially Continental, designs. This is attained, first, by carefully designing each member of a machine to perform as many functions as possible; second, by making it up of as few pieces as possible; third, by making those pieces of as simple a shape as possible, and adapted to fast and easy operations in special tools. Such designing requires much thinking of the highest order, supplemented by both experience and forethought. Not only must the machines be good, and strong, and simple, and beautiful, but each member and component piece therein must have the same qualities. In addition, each operation upon such pieces, and each tool to perform it, together with the master tools for keeping in order and reproducing the same, must be thought out beforehand, and a complete plan formulated for future manufacture.
>
> Whether the American people, with their industry, skill, and common sense, inherited from the Mother Country, supplemented by various peculiar conditions of environment, have been led to a higher appreciation and practice of the development of the generic principle we have been discussing is a question for the world to consider and, perhaps, to profit by. It seems to many Americans that this is the case, and that this principle happens to have been developed to a somewhat higher degree among them than elsewhere. If this is true, it will doubtless account for a good deal of the export trade from the United States abroad. Whether, and to what extent, the methods in question will serve as an object-lesson to other nations, remains to be seen. In regard to the primal cause of peculiar developments like the one in question among different races and nations, nothing more need be herein said, this being a question for the anthropologists and political economists.

The Engineer: October 13th, 1899.

The Locomotive Trade of Great Britain.
Incandescent Lamp and Transformer Construction in America.
Evans' Ingot Stripper.
Inland Navigation in Russia.
The Pneumatic Dispatch.
Acetylene Gas Lighting at Hawes.
Early Paddle-Wheel Steamships.
The Improvement of the Mouths of the Volga.
Modern Steam Engine Tests.
Duncan and Cornwallis Battleships.
Sutton Sewage Disposal Works.
Bristol Dock Developments.
Electro-Galvanising Boiler Tubes.
Official Trials of the "Shikishima."

Our contemporary of this issue contains an article which throws a new light on the much debated subject of the importation into England for home railway service of American locomotives. In addition to some points that have already been dealt with, *Engineering* instances a circumstance

to which it attaches great weight, and whose importance indeed in influencing the foreign locomotive trade can hardly be over-estimated. Says *Engineering*, which we are obliged to quote at some length :—

A large proportion of that foreign trade on which our locomotive engine shops depend for work comes through civil engineers. In few words, "Great George Street gives out the orders." We have shown that in the United States, contrary to much that has been said in this country, locomotives are built for the railway companies under careful inspection. But we have cause to say that that inspection is reasonable, and in this country unreasonable. The Baldwin Locomotive Works can, it is said, turn out about one engine per annum for every five men employed. That is to say, with 5,000 men they will build 1,000 engines. In this country the output is just about half. Something of this is due to the American workman, who does more than the English or Scotchman, something to special tools. But in the main the output with us is less than in the States, because, in the first place, less intelligence is manifested in the preparation of the design to facilitate work; and in the second place, much more obstruction is caused by inspection. Thus, to give particulars. Complicated and difficult forgings are ordered, where steel castings would be much cheaper and more readily obtained. Scrap iron is specified for motion work, instead of steel. The smallest specks or reeds in the surface lead to the condemnation of the part. In one instance an order for a considerable number of locomotives was greatly delayed because the inspector rejected about one-third of the sets of motion work, on account of minute surface defects; and this, be it remembered, after the work had all been finished and was ready to put in place. In boiler work, again, an inspector will measure with a pair of dividers the pitch of the rivets in a seam. If they are not exactly right, he causes the offending rivets to be cut out and replaced. As many as one-third of all the rivets in a seam have thus been taken out, and it is, of course, impossible to say which is the erring rivet. The result is great delay, great expense, and injury to the boiler. The duty of an inspector begins and ends with seeing that he gets satisfactory workmanship and materials; and he ought to know that the circumstance that a few rivets in a seam are out of pitch by a small fraction of an inch will in no conceivable way affect the durability or safety of the boiler. In the United States there is no inspection of this kind; indeed, we may venture to say that it is the exclusive property of Great George Street. The same system is carried right through. It extends to the testing-room. It affects the chemical composition of the steel. But the worst feature is, perhaps, that it entails great and quite unnecessary delay in the execution of orders. At a time when there is a sharp demand, firms ought to be able to turn out engines quickly; if they cannot, then orders will pass over their heads, and find their way abroad. For this Great George Street cares nothing. It has always worked on a particular system—it does not intend to change with the times, or adopt the methods of younger men.

But, it may be asked, why is it that the locomotive engine builders of Great Britain should be so dependent for orders on Great George Street. It is easy enough to answer this question. In the first place, orders do not come from our railway companies save in time of stress like the present, because it is held that the companies can build much cheaper than they can buy. This is a matter on which we find it impossible to speak with any certainty. Most of the private builders assert that they can supply engines of the same quality as those built in railway shops for the sum they really cost the companies, who invariably charge too little to the engines. The railway companies flatly contradict this, and state that their books show accurately and minutely what the cost is. There are various ways of looking at the matter. The fact remains that the private builders get very little from the home railways. There seems to be small room to doubt that up to a comparatively recent period they trusted far too much to orders being placed unasked for; and to this is mainly due their reliance on the civil engineers for work. We use "Great George Street," of course, only as a general term, but matters appear to progress much as follows :—A railway concession is obtained abroad. Civil engineers are sent out, say, to China, to exploit the district. They construct the line, and when they are ready for rolling stock they send home orders. The British builder waits until such orders come. It is not strange that under these conditions Manchester and Glasgow should have to rely on Westminster for work. The American does nothing of the kind; the moment he hears of a concession, the representative of some one or more American firms goes to the place. He takes infinite pains to explain what his engines can do; he has his drawings, his photographs, his specifications, his testimonials all ready. He is prepared to take all the trouble; he will save the civil engineer as much worry as possible, and he gets his order, and he deserves it. Furthermore, the American takes care that the world shall not be in ignorance of the work he is doing. He blazons it forth that he builds engines for every country under the sun. With us locomotive builders observe the utmost secrecy. They will scarcely permit their right hands to know what their left hands are doing. For this they are only partly responsible, for a Great George Street rule is that strict secrecy is to be observed about contracts. An immediate result is that the intelligent foreigner can scarcely be induced to believe that Great Britain builds any locomotive engines at all, and this at a time when hundreds of engines are being turned out.

There is also an interesting article on the inception of the Dominion Coal and Steel Company at Sydney, Cape Breton, with a paid-up capital of £4,000,000. It is anticipated that the establishment of this important manufacturing concern will mark an epoch in Canadian manufacturing history.

The Engineer: October 20th, 1899.

Incandescent Lamp and Transformer Construction in America.
Heavy Motor Car Trials in France.
Bacterial Treatment of Crude Sewage at Crossness.
Heavy Planing Machine.
Electrically-Driven Planing Machine.
Early Paddle-Wheel Steamships. II.
Carnegie Thin Krupp Armour for Russia.
The Fastest Long-Distance Trains in the World.
White Star Steamship "Vedic."
Recent Public Works in Ireland.
Bacterial Sewage Works at Hampton-on-Thames.
Railway Carriage Making Machinery.
The Twin S.S. "America Maru."

The public interest in the Bacterial Treatment of Town Sewage is reflected in our contemporary, which is devoting a large proportion of its space to the subject. The articles on Bacterial Treatment at Hampton and at Crossness (two separate articles) are both illustrated.

The Engineer: October 27th, 1899.

Electrical Engineering in Switzerland.
British and American Machine Tools. I.
Some Notes on Russia. VI.
Engines for the Sheffield Electric Tramways.
Engines on S.S. "America Maru."
Warships under Construction in the United Kingdom.
Single-Cylinder Road Locomotive.

Early Central Buffer Systems.
Electric Tramways and Light Tramways in London.
French Submarine Boats.
Early Paddle-Wheel Steamships.
Germany's Survey for the Bagdad Railway.
The Outlook in the Coal Trade.
A Remarkable Accident.
Balance Rudder S.S. Stentor.
The Lubricating Oils of Different Countries.
The Venturi Water Meter.
The Swedish Iron and Steel, Metal and Coal Industries in 1898.

An article of some interest on American shipping, and the effect upon it to be anticipated by the recent withdrawal of a number of vessels from mercantile service that has been caused by the South African war, appears in this issue.

The Engineer: November 3rd, 1899.

The Purification of Acetylene by means of Chloride of Lime.
The Canal System of Canada.
British and American Machine Tools.
Utilisation of the Nile.
Institution of Mechanical Engineers.
Paper Driving Ropes.
Early Paddle-Wheel Steamships. IV.
Well-boring Apparatus.
Pumps for the Assouan Dam Works.
Armour-protected Troops.
Traction Engines in War.
West Kootenay Electricity Supply.
Diluted Acetylene for Railway Lighting.
Edward Lyon Berthon.
Mining at Great Depths.
Incrustation of Water Pipes at Torquay Water Works.

Our contemporary, the *Engineer*, has taken from the first an active interest in Acetylene. We quote from an article on the purification of this gas in which the use of chloride of lime, otherwise bleaching powder, under certain conditions is more effective than any other agent for the purpose. In reply to suggestions that the chloride should be mixed either with very little water, or with a very large quantity of sawdust to make it quite safe, the *Engineer* submits that the total avoidance of organic matter of wood is distinctly advantageous, and continues:—

> Quite recently an accident occurred in a mill at Wurtemberg, where chloride of lime, mixed with kieselguhr, was being used; the water seal of the purifier was blown out, the holder bell was lifted, the gas caught fire and suffocated several workmen, who remained unconscious for some time. After the explosion the purifying material was found to be pasty with water, although it had been introduced into the vessel in the dry state. This catastrophe seems to have been due to the gas passing directly from the generator into the purifier very hot and loaded with moisture; not improbably, also, the carbide was unusually bad, and the acetylene contained a notable proportion of ammonia. The trouble was aggravated by the employment of an abnormally large purifier; for it is reported that some ninety times more chloride was present than was necessary to deal with the whole of the gas evolved by the generating apparatus.
>
> Thus we see that by keeping the original acetylene free from too much moisture, removing the ammonia, treating it with chloride of lime, diluted, if necessary, with some inert inorganic substance, and making it afterwards pass through a vessel of slaked lime, more of the impurities in the crude gas are extracted than if the Frank or the Ullmann process be adopted. The operation is said to be simpler for a non-chemical attendant; it is obviously far cheaper. The one disadvantage of the purified gas, its minute percentage of carbonic oxide, is far too trivial to be considered; and no fear need be felt that the half-spent material may become a source of danger by actually catching fire.

The Electrical Review: October 13th, 1899.

Siemens and Halske's Wehnelt Break.
The Stresses in Crank-Shafts.
The Practical Limitations of Dry Batteries.
Aluminium Conductors.
Electricity on Canals.
Llandudno Electricity Works.
Electric Wiring Systems.
Experiments on Rail Bonds.
Labour and Production.
Signalling Without Contact.
Some ill-tempered American Criticisms.
Popular Science.
Electric Light Stations.

Electrical Review: October 20th, 1899.

Measurement of the Internal Resistance of Accumulators.
Electrographs made without a Camera or Electrostatic Current.
The Mechanism of the Wehnelt Interrupter.
Electric Traction in this Country.
The Shoreditch Refuse Destructor.
Alderly and Wilmslow Electricity Works.
An Attempted Two-Cycle Gas Engine.
The Unspeakable Trolley.
The Future of Water-Power and Electrolytic Alkali Processes.
Pumps for Central Stations.

We are pleased to see that the *Electrical Review* takes an inspiriting view of the prospects of British electric traction. In its own words:—

> To deplore the want of progress in electric traction work in this country was all right a short time ago, but anyone who has made a serious inquiry into the dimensions which such development has now assumed can hardly say that our movements during the past few months are "laggard." We drew attention to this matter in a "Note" last week, and we repeat that electric tramway work is now progressing at a most satisfactory rate. Whatever we may have done or left undone in the past, let us now profit to the fullest possible extent by the costly experiences of our foreign *confrères*, and see that the work we take in hand is done thoroughly and well. Better thus than to continue hugging ourselves in our disconsolate state, and shedding a lake of tears overwhat might, or even ought, to have been.

In another column the *Electrical Review* devotes some space to a consideration of a novel form of Two-cycle Gas Engine, described in FEILDEN'S MAGAZINE for the first time in its October issue. Our contemporary describes the idea on which its principle is based as "admirable."

The Electrical Review: October 27th, 1899

The Municipal Management of Electricity Works.
The Magnetisation of Cobalt.
Brush Rocker Details and Bearings.

The "Same Circuit" Method of Incandescent Lamp Photometry.
Oil Engine Tests.
Prof. Smith on Governors.
What is a "Factory?"
A 600-K.W. Alternator for Sheffield.
Electro-Pneumatic Signalling.
Brisbane Electric Tramways.
Cowper-Coles Sound Locator and Projector.
Railway Power Distribution over Large Areas.
Volta and the Voltaic Cell.
Some Features of the Electric Induction Motor.
Electric Traction in South Staffordshire.
The Penalty Clause.
Fog Signalling on Railways.

We notice in this issue of our contemporary, one of the most *live* of technical periodicals, a criticism couched in sprightly terms of a contribution by Professor Robert Smith in the October number of FEILDEN'S MAGAZINE. The *Electrical Review*, it would appear, does not question Professor Smith's correctness, nor the value of his article, but attempts to find fault with his literary style. We are glad to see that the *Electrical Review* does not regard its normal duties so oppressive as to preclude its taking an occasional excursion into literary criticism.

The Electrical Review: November 3rd, 1899.

Electro-Pneumatic Signalling.
An Electrolytic Method of Sharpening Files.
Electrical Distribution of Motive Power.
The Sullivan Signalling Galvano-Meter.
Transmission of Power in Factories.
South Shields Corporation Electricity Works.
Transmission of Power by Gas.
A New Copper Bond.
American Competition.
Engines with Direct-Connected Dynamos.
Installation of Steam Boilers.
Units of Measurement.

The Electrician: October 20th, 1899.

Contemporary Electrical Science.
Low-Voltage Dynamos.
Volta and the Electric Pile.
Signalling without Contact.
Transformer Tests.
Tests for a Forty-Mile Aluminium Cable.
Electricity Works Accounts (Harrogate).
The Chemical and Contact Theories.
An Interesting Pressure Curve.
Submarine Telegraphy in the Navy.
The All-British Cable.

The Electrician: October 27th, 1899.

Snoqualmie Falls Transmission Plant.
A Large Inductor Alternator.
Electricity Works Accounts (Shoreditch).
Sounds Emitted by the Electric Arc.

The *Electrician* in this issue gives some details respecting the Woolf Electrolytic System of Disinfection employed in Havana. The particulars are taken by our contemporary from an American paper:—

> When the American authorities succeeded the Spanish in Cuba they experienced great difficulty, as is well known, in cleansing the city of Havana of yellow fever. As an aid to the much-needed process of disinfection it was decided to employ the Woolf electrical process for the production of hypochlorites from sea water. A battery of four boilers and two Ames engines of 250 h.p. furnish the motive power. The engines are belted to a counter-shaft, from which there are at present operated four Crocker-Wheeler dynamos of 100 kilowatts each, supplying 4,500 amperes each at 12 volts. The machines are separately excited by an 18-kilowatt exciter. There are eight electrolising vats, into which sea water is pumped from the bay, each containing 417 positive electrodes and 425 negative zinc electrodes. The current is six volts per vat, the vats being run two in series. The positive electrode, being the one subject to attack from the gases evolved, is formed from an alloy of platinum and iridium, which material is not acted up upon by nascent chlorine. This electrode is immersed at a distance of about $\frac{1}{2}$ in. from the negative electrode. In the process of electrolysis oxygen and chlorine collect at one electrode, and hydrogen collects at the other, whence it rises to the surface, and escapes into the air. The chlorine and oxygen unite with the bases, forming hypochlorites, which are powerful disinfecting agents. The capacity of the plant is 160,000 galls. per 24 hours.

The Electrician: November 3rd, 1899.

Behrenberg Incandescent Lamp Factory.
A Small Dowson Gas Electricity Station.
Apparatus for obtaining High Frequencies and Pressures.
Electricity Works Accounts (Yarmouth).
Electric Traction in Chicago.

In a note based on a paper read before an American Convention, the *Electrician* gives some details relating to electrolytic action on underground pipes:—

> In earlier days the most generally accepted method of dealing with electrolysis was to attach a bond wire to the damaged spot, and Mr. Wynkoop states that by means of these bonds some of the companies concerned are caring for stray currents ranging between 20 and 80 amperes. Each of these companies or corporations has its own expert and its own remedies, regardless of the effect on its neighbours. The cast-iron water pipes belonging to the city and the cast-iron pipes of the gas company have enjoyed immunity from electrolysis. These pipes consist of a very hard, dense, heavy-grained white cast-iron containing alloyed rather than combined carbon, and coated with some variety of asphaltic varnish. On the other hand, the wrought-iron and steel service-pipes in the gas system have been attacked, and the company is suffering from an abnormal leakage of gas. The cast-iron coupling boxes of the Edison Electric Illuminating Co. have also been badly corroded in places. Singular expedients have been resorted to in order to secure relief from electrolysis. In one case a pipe had been carried across the street to avoid near approach to the rails. In other instances heavy rubber hose had been slipped over the lead service lines in places where electrolytic trouble had been experienced. The electrical remedies, the author states, have thus far failed. An improved track return was a palliative, but not a cure. Nor have interbonding, the application of an auxiliary potential, or the insertion of insulating sections of pipe along the pipe lines fulfilled anticipations, and all up to the present have only afforded a temporary and not a permanent relief. The author concludes that the problem must be attacked from the standpoint of chemistry. Such disastrous consequences as these need not be anticipated in this country, where sufficiently strict Board of Trade Regulations as to insulated returns and earthed returns have been enforced from the outset.

Journal of Gas Lighting: October 17th, 1899.

Commercial and Technical Education.
The Expansion of Germany.
Water Acts for 1899.
Dimensions of Gas Plant.
Equality in the Supervision of Gas and Electricity Supplies.
Papers Read at the Acetylene Congress.
Thawing Frozen Water-Pipes by Electricity.

Journal of Gas Lighting: October 24th, 1899.

The Settlement of Trade Disputes by Compulsory Arbitration.
Water Acts for 1899.
Papers Read at the Acetylene Congress.
The Use of Coke in the Treatment of Sewage.

Our contemporary makes the following remarks on the future of Incandescent Gas-Lighting :—

> It is not only that the gas is so much cheaper than the electric light, although this is, of course, a serious consideration with most people. Factory owners, shopkeepers, and others say they are relinquishing the electric light and, not exactly going back to gas, but rather going forward with it because it is so superior a light. The large firms and establishments cannot find anything in electricity to equal the new intensified patterns of incandescent gas-lights; and professional men and others having delicate work to do are losing patience with the incandescent electric lamp as usually worked by the supply companies. One writer asks if an electrical partisan has "ever tried to make a drawing, or do any kind of delicate handiwork, by a couple of so-called 16-candle electric lights," and he opines not, or he would surely understand the longing of all our office staff "to return to the incandescent gas-light which we had in our former offices."

Journal of Gas Lighting: October 31st, 1899.

Water and Sanitary Affairs.
Municipal Corporations (Omnibus) Acts for 1899.
Commercial and Technical Education in Germany.
An Example of Gas Engineering.
The Bandsept Incandescent Burner.

The article on Indigo in No. 2 of *Feilden's Magazine* appears to have excited a wide area of discussion, the matter being taken up by the *Times* and a number of other periodicals. The *Journal of Gas Lighting* expresses itself on the question as follows :—

> It is now some years since the successful synthesis of indigo from coal-tar products threatened the natural cultivation of the dye-plant; but the growers had a respite, due to the fact of the artificial pigment being dearer than, and not quite so good as, their own. Still, the appearance of the so-called artificial indigo was a warning to the growers of the plant to look out for themselves; but this warning was contemptuously disregarded. The growing and preparation of the indigo plant went on by the old methods, while the resources of modern chemistry were concentrated upon the improvement and cheapening of its rival. Recently it appeared that the indigo growers had taken the alarm; but their rivals declared it was almost too late. German indigo, a coal-tar dye, has almost rewarded the pains and expense lavished upon its production; while the natural dye-stuff remained just as it was—an almost accidental product of one of the rudest and most wasteful of agricultural operations. So far had the matter gone, that the *Times* the other day discussed the Indian indigo cultivation as a dying industry. This conclusion has since been denied. It is admitted that, in the absence of competition, the indigo industry in India has not improved upon the methods of a hundred years ago. A few chemists had looked into the process of preparing the dyes; but they were not encouraged by the planters. Growers, buyers, dealers, all united against anything new. Meanwhile the world had been going on regardless of them and their prejudices, until one fine day indigo that had not passed through their hands was quoted in the market. Then the old stagers began to put their house in order. They called in the chemists, whom they had previously despised, and told them to improve things generally. Unfortunately, much valuable time had been lost. Nobody knew anything about the *rationale* of indigo production from the plant, which does not, as a matter of fact, contain it as such. Its production is now believed to be a question of microbes; and it is also thought that only about one-third of the dye in the plant is obtained by the traditional methods, and that even of this poor yield 20 per cent. is wasted. Hence there is an ample margin for such a degree of improvement of the natural industry as will enable it to withstand the competition of the artificial dye. There are many "morals" to be drawn from this story, by those who will take the trouble. Gas and coal-tar manufacturers will look on the struggle with impartiality amounting to indifference, as the prosperity or otherwise of the coal-tar colour and drug trade does not seem to strike back to the market for raw material.

Journal of Gas Lighting: November 7th, 1899.

Shareholders and Auditors.
The Home of Compulsory Arbitration.
A Retort Oven Gas Plant.
The Jubilee of the London Coal Exchange.
Local Administration and the Public Health.
Sound Gas Fittings.
Estimation of Benzene Vapour in Gas.
The Law Relating to Underground Water.

Britannia: November.—For some time past we have been in receipt of this bright and patriotic organ, and have always taken it up with pleasure. *Britannia* is an enthusiastic advocate of what British statesmen are beginning more and more to recognise must in future be the guiding influence of their national policy—the federation of the Empire. We have been favoured with some advance proofs of the December issue, including a well-written article on the Duke of Wellington. *Britannia* is published monthly by the well-known publishers, P. S. King & Son, of Westminster, and includes in each issue a full-page cartoon by John Proctor. The journal is now in its fifth year, and is to be still further enlarged.

AMERICAN.

Modern Machinery: November. — Our contemporary of this issue makes the following reference to the growing use of gas-engines in the United States :—

> The building of gas-engines has reached a point in this country where the need of established and accepted standards is beginning to be felt. The industry is passing through a period where intelligent and conservative discussion and action are required.
>
> There are many problems to be considered, and many points in construction and design to be modified before the best results can be obtained, and the meaning of terms, especially those concerning capacity and requirements, of the several types of engines, must be clearly

defined and determined before those engaged in the development of the industry can work to the best advantage. The steam-engine builders have had a similar experience; the electrical engineers are now perfecting their system of standardization, and the gas-engine builders must take similar action unless they are willing to have their field abandoned. A meeting of those interested in the subject should be held to formulate a plan of action.

Modern Machinery also makes a statement which must be considered as somewhat sanguine in reference to the adaptability of primary batteries to electric vehicles:—

The electrically propelled vehicle in which a storage battery is used is too heavy for steep grades or dusty, sandy and muddy roads. The difficulty in obtaining the necessary charging current outside of cities or large towns confines the use of the machine to the thickly populated districts. The amount of current that can be stored is limited, and the vehicle is therefore restricted to short runs, which makes it necessary to provide charging stations at frequent intervals along the road to be travelled.

These difficulties could be remedied by the use of a primary battery, and the success of this arrangement is by no means so impossible as many may suppose. In fact, the first successful motor vehicle in Chicago, which made its appearance in 1892, was propelled by current supplied by primary batteries. A primary battery should weigh about one-fifth as much as an equally effective storage battery, and enough chemicals to propel the vehicle at a high speed for a distance of 75 miles could be carried in a box a foot square. The vehicle could thus be made much lighter, charging stations would not be required, and the advantages of easy control, safety, &c., would be secured.

American Manufacturer.—We notice in the issue for November 9th of this paper, an interesting *résumé* of some investigations and tests made at the Sibley College, for determining the relative merits of wire and cut nails. The conclusions arrived as the result of the experiments are of some importance, as per following:—

Summing up the results of the experiments, they may be said to show that (1) cut nails are superior to wire nails in all positions; (2) the main advantage of the wire nail is due to its possessing a sharp point; (3) if cut nails were pointed, they would be 30 per cent. more efficient in direct tension; (4) wire nails without points have but one-half their ordinary holding power; (5) the surface of the nail should be slightly rough, but not barbed—barbed decreases the efficiency of cut nails about 32 per cent.; (6) nails should be wedge-shaped in both directions when there are no special dangers of splitting; (7) the length of nails to be used in tension should be about three times the thickness of the thinnest piece nailed; when used in shear about twice this thickness is sufficient; (8) the relative holding power in different woods is as follows: White pine, 1; yellow pine, 1·5; white oak, 3; chestnut, 1·6; beech, 3·2; sycamore, 2; elm, 2, and laurel, 2·8; (9) nails usually hold about 50 per cent. more when driven perpendicular to the grain than when driven along it; (10) nails are always strongest when driven perpendicular to the surface of the timber; (11) when subjected to shock, nails will hold less than one-twelfth the load they will stand when weight is applied gradually.

The same issue contains the annexed information:—

The steamer "Falls of Keltie," arrived at Rangoon, September 4, from New York, with 20 locomotives and 75 railway carriages and other parts of railway machinery for the Burmah railways. Mr. J. J. Ellis, of Messrs. Barber & Co., New York, has been specially sent out by this firm, which has chartered the "Falls of Keltie," and is the agent of various well-known American iron companies, to superintend the work of delivering the machinery. This is the first voyage of the "Falls of Keltie" to Rangoon. She left New York on the 24th of June, and Alexandria on the 18th of July, arrived at Aden on the 3rd of August, Bombay on the 13th, and Colombo on the 27th, and left again for Rangoon on the 29th. She left New York with the largest quantity of machinery that was ever put aboard one boat, viz., railway material for Alexandria, Bombay, and Rangoon, and American oil for Colombo.

Electrical Review (U.S.A.).—In the issue for Nov. 8th appears this announcement, which will be found referred to in the Editorial pages of this journal:—

The Glasgow (Scotland) Corporation Tramways, which are owned by the municipality, have just contracted with the National Conduit and Cable Company of New York for two million feet of wrought iron cement-lined, three-inch conduit pipe for their feeders. The British headquarters of the Conduit Company are at 23, College Hill Chambers, London, E.C., and Mr. George J. Jackson, Secretary of the Company, is spending a few months there. The new street railway installation in Glasgow will be almost wholly American, the engines, dynamos, conduits and many other parts of the system coming from the United States.

The Manufacturer.—This journal—the monthly organ of the Manufacturers' Club of Philadelphia—contains some information of the first oil-pipe line laid down in Russia:—

It runs, says *The Manufacturer*, along the Trans-Caucasus railway route, between Michailovo and Batoum. A large reservoir has been built at the former place, into which the oil brought from Baku is poured in order to be pumped through the pipe line to Batoum for shipment. The railway, it is said, can no longer transport with sufficient expedition the increasing quantities of oil from the Caspian. The pipe line will eventually be prolonged to Baku itself. In order to construct this line the Government had, first of all, to aid in the establishment of works at Marinpol, on the Sea of Azoff, for making the pipes, as none of the kind necessary for this purpose had ever been made in Russia before. It is for these works that considerable equipment was recently purchased in the United States. The processes of manufacture were not understood at first, and the first lot of pipes was rejected. Now that one has been successfully opened there is talk of establishing other lines from the petroleum regions to Black Sea ports and even up to Moscow and St. Petersburg.

BOOKS RECEIVED.

(Acknowledgment in this column does not preclude further notice where necessary.)

NOTES ON THE CONSTRUCTION OF CRANES, ETC.: Technical Publishing Company.

PROBLEMS IN MACHINE DESIGN: Technical Publishing Company.

THE "PRACTICAL ENGINEER" POCKET-BOOK: Technical Publishing Company.

THE CONSTRUCTION OF ROADS: Macmillan.

PRACTICAL PLANE AND SOLID GEOMETRY: Macmillan.

HEAT, FOR ADVANCED STUDENTS: Macmillan.

THE ELEMENTS OF PHYSICS: Macmillan.

NEWTON'S LAWS OF MOTION: A. & C. Black.

A TEXT-BOOK OF PHYSICS: Longmans, Green & Co.

MAGNETISM AND ELECTRICITY, FOR BEGINNERS: Macmillan & Co.

REVIEWS OF BOOKS . . .

Publishers would oblige by stating the price of books sent for review.

RECENT BOOKS.

The Yangtze Valley and Beyond. An Account of Journeys in China, chiefly in the Province of Sze Chuan and among the Man-Tze of the Somo Territory. By Mrs. J. F. Bishop. London: John Murray, royal 8vo, 557 pp. Illus. 16s.

This handsome and beautifully illustrated volume will be found full of interest to the student of China, whether of the Chinese character, manners, trade or topography. Its accomplished authoress has given her attention to the more salient features of the country and its inhabitants, as they would strike an intelligent observer, and expressed her ideas in a clear, agreeable style. The book, however, with all its store of varied information, only conveys the idea after its perusal that our knowledge of China and the trend of thought of its diversified inhabitants, is almost as deficient as that we ascribe to them about ourselves. Chinese society, its laws, institutions and manners, in the estimation of the people were perfected many years ago; and the mere idea of an ignorant foreigner with his new-fangled mechanisms attempting to assume a position of equality even, is generally provocative of the sincerest indignation. It is quite evident from Mrs. Bishop's perspicuous narrative that the Chinese, far different from the Japanese, from whom they are alien, indeed, to an enormous degree, are not to be induced without the greatest difficulty to do business excepting on their own lines; lines that have descended to them from countless forefathers, and which are preserved and consecrated to generations of the time to come.

It is true the potentialities of China are colossal; but they are locked up tightly in the bands of the severest conservatism to be found on earth. It is in the nature of the Chinese national character that the greatest obstacles have been found in the past to the "opening up" of the country, and which will operate against the continuance of the process in the future.

To Europeans, China is a barbarous country. Its manners, customs, tendencies, and social principles are all strange, sometimes incomprehensible; and it is natural Europeans should attempt to exercise the same means of advancing their influence, and securing the respect of the "natives," which have been found successful in "barbarous" countries in other parts of the world. This is a killing mistake. As Mrs. Bishop points out with an amply justified insistence, the first condition of success to alien commercial enterprise in China is to *understand* the people. To understand the people it is necessary to know their language, and in this respect the authoress remarks that if more time were given by men of business in China to the learning of Chinese and Chinese requirements, and less to amusements, there might be less occasion for the complaint that large fortunes are no longer to be made in China. The consequence is, as pointed out, that the *shroff* or *Compradore* possesses a most inordinate control in a large proportion of the English business establishments at the open ports.

Mrs. Bishop is a strict advocate of the "open door," as against the "sphere of influence" policy, and, notwithstanding the weighty trend against Western civilisation, foresees the day when it will be practically accepted by the Chinese. But the Chinese are not to be bullied, or "rushed." What they may take must be of their own free will. Mrs. Bishop, in this regard, lays stress on the value of the "object-lesson." That is, the practical working of railways, telegraphs, electric light, and so on, before the inspection of the Chinese themselves. They soon learn to appreciate their value; and instance after instance of this is occurring at the present day.

We must congratulate the authoress on the accession to her geographical works of this beautiful volume, the value of which is materially enhanced by its 116 photographic reproductions.

A History of Wireless Telegraphy, 1839-1899, including some Bare Wire Proposals for Subaqueous Telegraphs. By J. J. Fahie, M.Inst.E.E. John Blackwood and Sons, Edinburgh and London. 325 pp. Illus. Post 8vo, 6s.

This book is exactly what it professes to be: a History of Wireless Telegraphy. It is quite up to date, but contains little or nothing new to the professional electrician. Its contents, however, will probably come as a surprise to the general public. "Wireless Telegraphy," "Telegraphy without Wires," "Etheric Telegraphy," "Ethereal Telegraphy," and so forth, has been so "boomed" by the popular press that most people regard this form of electrical communication as an entirely new invention suddenly sprung upon the public. In principle it is very old. In his lucid survey of the subject, Mr. Fahie traces back the theory of electric communication without material connecting mediums to a very distant period. As far back as 1795, wireless telegraphy occupied the minds of inventors, whilst in 1838 Steinheil, inspired by some experiments, actually raised the question whether it was necessary or not to have *any metallic communication at all in carrying on telegraphic intercourse.*

During the following years we have a succession of electrical experimentalists engrossed at different times in this question. In 1842, Professor Morse was actually successful in making water the electrical conductor, and instituted electrical communication without wires across a river, and suggested "lofty spars on which wires may be suspended" as a means for facilitating the communication.

T. W. Wilkins, in 1845, considered that telegraphing without wires might be a possibility, and it is stated that about that date he "constructed a most sensitive instrument by which

he succeeded in obtaining actual signals between lengths of elevated wires 120 feet apart." J. Bowman Lindsay, that unfortunate Scottish scientist whose speculative insight into existing scientific problems was in inverse proportion to the practical results he obtained from them, actually read a paper on "Telegraphing without Wires" in 1859, before the British Association in Aberdeen. The practical solution of the problem was predicted by Sir William Crookes in 1892 in an article published in the *Fortnightly Review*, and the means by which it could be accomplished set forth in clear terms.

Finally, we come to the time when Marconi arrived from Italy with the nucleus of his present system. It will always remain on record to the credit of Sir W. H. Preece, then Chief Engineer to H.M. Post Office, that although himself engaged in experiments of the most promising character with wireless telegraphy, he nevertheless gave the most immediate and amplest recognition of the claims of his rival, and in every way assisted him to bring them before the attention of the Government. The recent history of the subject is too well known to require attention. We welcome this book. It is lucid, comprehensive and accurate, and will no doubt receive the recognition to which its merits entitle it.

Notes on the Construction of Cranes and Lifting Machinery. By Edward C. Marks, Assoc. M. Inst. C.E., M.I.M.E. Technical Publishing Company, Limited, Manchester. New and enlarged edition. 183 pp. Illus. Post 8vo.

"Lifting machinery," says the author, "embraces a very wide range of appliances, from the simple pulley and screwjack to the monster cranes to be met with in our dock-yards and elsewhere, capable of lifting and lowering weights of tens and even hundreds of tons. A subject of such magnitude, therefore, cannot be treated fully in the limited space available, and only the more prominent examples have been selected for consideration." The author divides his work into, roughly, two parts. The first is devoted to an exposition of the theoretical principles involved in the appliances he describes: the second to a description of a number of examples of well-known varieties of cranes, lifts, and derricks. The latter is illustrated mostly by zinco-blocks reduced from wood-cuts, and although, doubtless, sufficiently intelligible when coupled with the associated letter-press, it cannot be said that the effect is particularly ornamental. A number of supplementary chapters have been added in this edition dealing with electrical cranes and some recent modifications in lifting plant.

NEW CATALOGUES.

Cableways, Hoisting and Conveying Devices: Cable Conveyors and Hoists. John Henderson, King Street Engineering Works, Aberdeen.

The use of cables as an easy and economical means of transport has been much developed during late years, and the Catalogue before us represents what may be regarded as up-to-date practice in this important branch of engineering. We understand that Mr. John M. Henderson has orders in hand for cableways, hoisting and transporting machinery which, when completed, will be capable of handling an aggregate of all kinds of materials of something like 3,300 tons per working hour. These plants will be used in demolishing and rebuilding two bridges, building one new bridge, excavating six large docks, building several railway viaducts and excavating a water reservoir. The remainder will be used in quarries, including two slate quarries, two freestone quarries, a large number of granite quarries, &c., and two plants for open-pit mines. Besides the large cableway which this firm recently completed at Vauxhall Bridge, there will be put in operation this month in London the cableway over the Thames at Kew for demolishing the old and building the new bridge. There is no doubt that by the use of such hoisting and conveying appliances as are described and illustrated in this book, materials in almost any situation, and under almost all conditions, can be handled at a cost per ton hitherto unheard of. Contractors, quarry owners, and others interested, should obtain a copy of this pamphlet, which contains diagrams and illustrations conveying a very clear idea of the apparatus and system employed.

Machine Tools. Niles Tool Works Company, 39, Victoria Street, London.

The Niles Tool Works Co. have forwarded us their catalogue. One of its most noteworthy features is that the company has made a start with electrical machine tools, as the list includes a very excellent type of portable electric drill, to drill holes up to two inches in diameter in steel. Another important speciality is the 12-inch heavy crank slotting machine with a Whitworth quick return shaft. The cam movement of the feeds is very good. Another is a new 22-inch engine lathe, of the most modern construction and design. The carriage has an unusually long bearing on the lathe-bed, thereby greatly increasing its expectation of life. The lathe is as nearly perfect, of its kind, as it can well be. Boring and turning mills, which are very modern machines and have many important advantages over lathes, are a speciality of the Niles Tool Company. Their catalogue, as might be supposed from the huge business done, is very voluminous, being over 500 large octavo pages, and forming a complete directory of machine tools of every description. The company has, by the great reputation it has deservedly acquired, put our own tool-makers on their mettle. The effect of the resulting competition can only be good for all concerned, the competing producers as well as the consumers of the tools, and we expect one day to see the largest machine tool works in the world—for such the factory at Hamilton, Ohio, undoubtedly is—rivalled in magnitude and output by a similar establishment in Great Britain. There is plenty of room on the top.

The Editor of FEILDEN'S MAGAZINE will be pleased to supply copies of any of the Catalogues noticed on this page, or to give further information.

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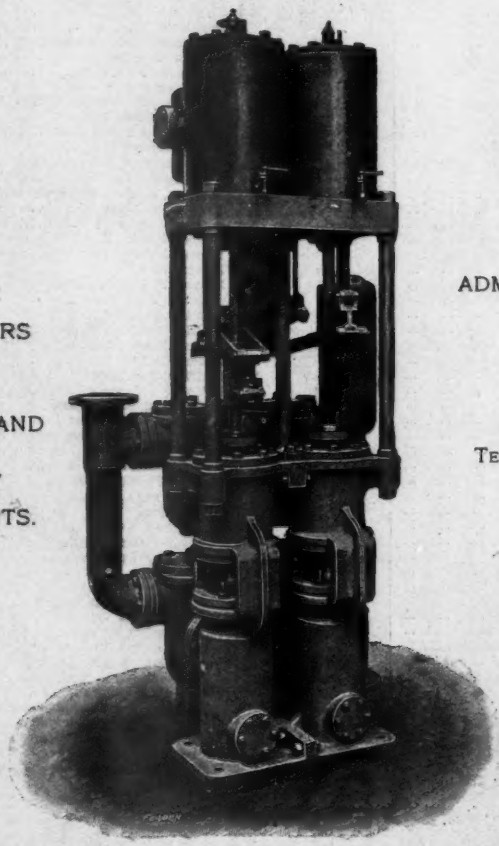

ON
ADMIRALTY LIST.

CONTRACTORS
TO
H.M. HOME AND
COLONIAL
GOVERNMENTS.

TELEGRAMS
"PUMPS,
MANCHESTER

WEST GORTON,
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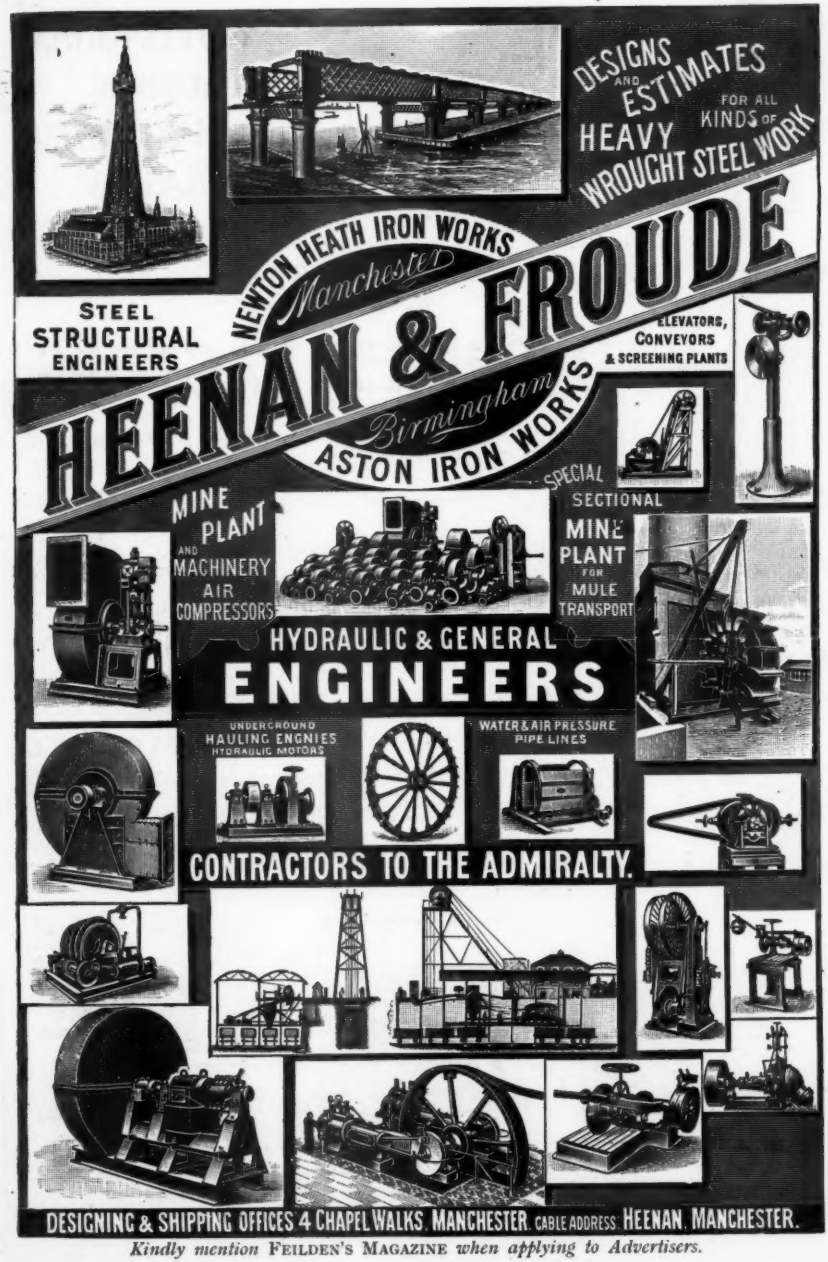
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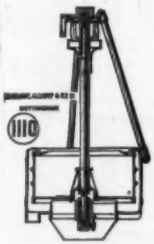

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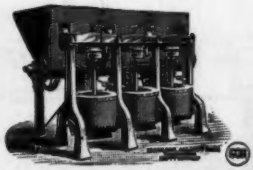

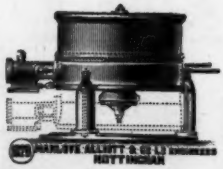

FEILDEN'S MAGAZINE DIRECTORY.

This list contains the names, postal, telegraphic and cable addresses, and codes used, together with the specialities manufactured by

Leading British Firms in the Engineering, Shipbuilding and Allied Industries.

For the benefit of the readers of this Magazine, the proprietors have organised a special department of their business, in which the Catalogues and Price Lists of the firms named in this Directory are preserved for reference. They can be consulted free of any expense at all times by subscribers to or advertisers in FEILDEN'S MAGAZINE, and any enquiries will be freely answered either by letter or personally.

This organization possesses special facilities for securing *inside* information not otherwise obtainable. Correspondence from any part of the world will receive immediate attention, and the wants and requirements of Foreign and Colonial buyers will be catered for in a manner hitherto but imperfectly done by other agencies. The most authentic information will be vouchsafed to readers as to the merits of the respective specialities advertised.

☞ *To ascertain the Names of Firms Manufacturing any of the Specialties in the following List, take the numbers indicated against each name and refer to the corresponding numbers in the List of Firms on pages* ix., xi., *and* xiv. *Those firms whose names, addresses and numbers are indicated in heavier type, have displayed announcements in this Magazine, to which attention is directed.*

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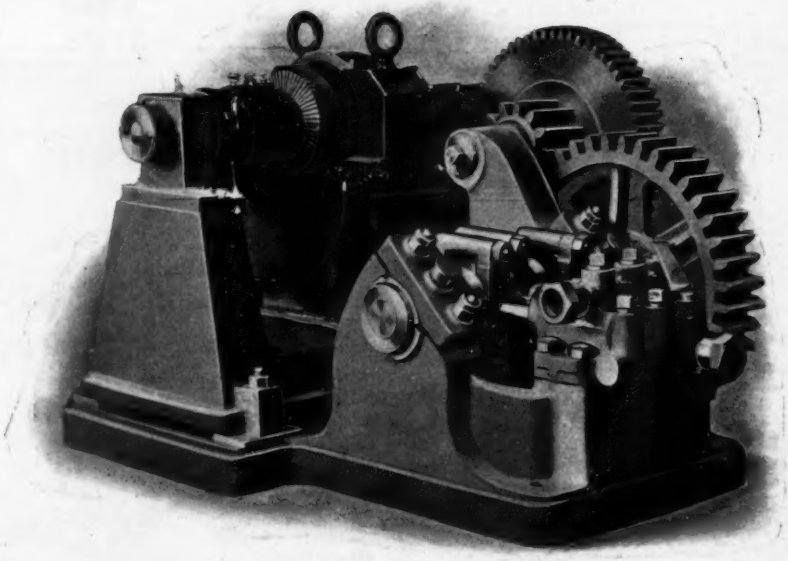

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Cette liste contient les noms et les adresses postales et télégraphiques des

Principales Maisons de Nations parlant la langue anglaise s'occupant de travaux du Génie, de la Construction de Machines et de Navires et se livrant à d'autres Industries analogues.

Avec indication du genre d'industrie dont chacune de ces Maisons fait sa spécialité.

Dans l'intérêt des lecteurs de ce Journal, ses éditeurs ont organisé dans leurs bureaux un service spécial pour la conservation des catalogues et prix courants des diverses Maisons figurant dans la liste, afin de pouvoir s'y reporter au besoin. Ces imprimés peuvent à tout moment être consultés, sans frais, par les abonnés du FEILDEN'S MAGAZINE et les personnes qui font paraître des annonces dans cette publication. On répond, en outre, soit par lettre affranchie, soit personnellement, à toute demande de renseignements.

☞ *Pour savoir les noms des maisons qui fabriquent quelqu'une des spécialtés comprises dans la liste suivante, prendre les numéros vis-à-vis de chaque nom et chercher les numéros correspondants dans la liste des maisons, sur pages* ix, xi, *et* xiv. *Les maisons dont les noms, adresses et numéros sont imprimés en caractères plus gras que ceux des autres, ont dans ce même Magazine des annonces spéciales et detaillées auxquelles nous appelons l'attention des lecteurs.*

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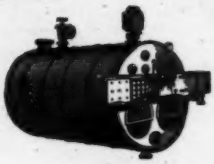

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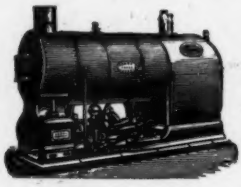

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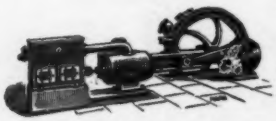

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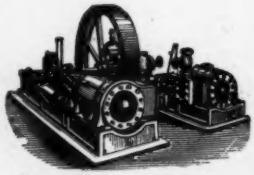

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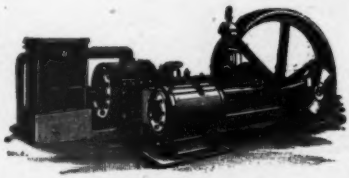

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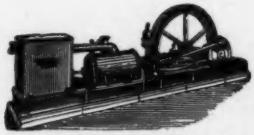

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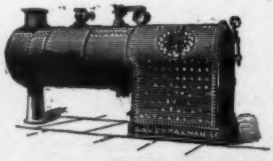

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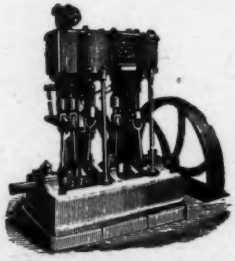

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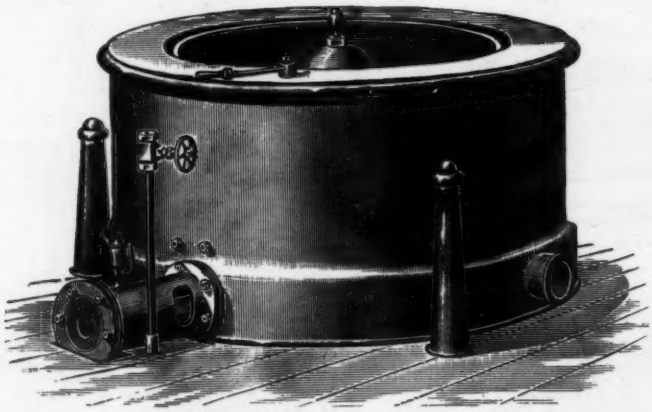

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B 17	**BRUSH ELECTRICAL ENGINEERING CO., Ltd.**	49, Queen Victoria Street, E.C. ...	Magneto, London ...	910 Bank ...	1, 2
B 18	**BRITISH SCHUCKERT ELECTRIC CO., Ltd.**	Surrey Street, Strand, London, W.C....	.....	1689 Gerrard ...	2, 11
B 19	**BROWN & CO.**	49, Deansgate, Manchester	Brownish, Manchester ...	4337	2
B 20	**BOBY, ROBT., Ltd.**	St. Andrew's Ironworks, Bury St. Edmunds	Screens, Bury St. Edmunds	.....	.....
B 21	**BOURNE, A., & CO.**	73, Ludgate Hill, E.C.	.....	.....	.....
B 22	**BROWN & MAY Ltd.**	North Wilts Foundry, Devizes ...	Foundry, Devizes ...	6	2
B 23	**BILLS, HANDLEY, & CO.**	50, Summer Row, Birmingham ...	.....	.....	.....
B 24	**BROWETT, LINDLEY & CO.**	Sandon Engine Works	Sandon, Patricroft ...	10, Eccles ...	.....
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B 26	**BRITISH WESTINGHOUSE ELECTRIC AND MFG. CO., Ltd.**	Norfolk Street, Strand, W.C.... ...	Multiphase, London ...	4045 & 4047 Gerrard	.....
B 27	**R. W. BLACKWELL & CO., Ltd.** ...	59, City Rd., London, E.C.	Kurkee, London ...	1497 and 1480 London Wall	1, 2, 6
C 1	CAMERON, JOHN	Oldfields Road Ironworks, Salford ...	Original, Manchester ...	2002	2
C 2	CAMMELL, CHAS., & Co., Ltd.	Cyclops Steel and Iron Works, Sheffield	Cammell, Sheffield ...	874	.....
C 3	**CAMPBELL GAS ENGINE CO., Ltd.** ...	Halifax	Hamgas, Halifax ...	92	3, 2
C 4	CLARKE, CHAPMAN & Co., Ltd.	Gateshead-upon-Tyne	Cyclops, Gateshead ...	.....	3, 2
C 5	CLAY CROSS CO.	Clay Cross near Chesterfield... ...	Jackson, Clay Cross ...	147	.....
C 6	CLAYTON & SHUTTLEWORTH	Lincoln	Claytons, Lincoln ...	43	4, 2
C 7	CLYDE RIVET WORKS CO.	Glasgow	Rivet, Glasgow ...	1574	.....
C 8	CROCHAN & CO.	Duke Street, Birkenhead	Multitube, Birkenhead ...	12	2
C 9	COLVILLE, DAVID, & SONS, Ltd.	Dalzell Steel and Iron Works, Motherwell, near Glasgow	Colville, Motherwell ...	.....	.....
C 10	CANDY, FRANK	109, Victoria St., Westminster, S.W. ...	.....	.....	.....
C 11	CONVEYOR & ELEVATOR CO.	Accrington, Lancashire	Conveyor, Accrington ...	.....	.....
C 12	COWANS, SHELDON & Co., Ltd.	Carlisle	S. Nicholas, Carlisle ...	1013	.....
C 13	**CUTLER & SONS...**	Providence Ironworks, Millwall ...	Retortus, London ...	59, Eastern ...	.....
C 14	**CLAPHAM BROS., Ltd.**	Keighley	.....	.....	.....
C 15	**CROMPTON & CO., Ltd.**	4, Queen Victoria St., E.C.	Crompton, London ...	663 Bank ...	1, 2, 3, 10
C 16	**COWPER-COLES S. & CO.**	Grosvenor Mansions, Victoria St., S.W.	Zincking, London ...	748, Westminster ...	2, 12
C 17	**CAPE ASBESTOS CO.**	8, Minories, London, E.C.	Incorrupt, London ...	272	1, 2
C 18	**COULTHARD & CO.**	Cooper Road, Preston, Lancs. ...	Coulthard's, Preston ...	140, Preston ...	.....
C 19	CENTRAL MARINE ENGINE WORKS	West Hartlepool	Central, W, Hartlepool ...	P.O. 18, Nat. 248	.....
C 20	CERES DEPOT	108, John Street, Adelphi, W.C. ...	.....	.....	.....
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D 2	DARLINGTON WAGON & ENGINEERING Co., Ltd.	Darlington...	Wagon, Darlington ...	5805	.....
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D 4	DE BERGUE & Co., Ltd.	Strangeways Ironworks, Manchester ...	Debergue, Manchester ...	1921	2
D 7	DICK KERR & CO., Ltd.	101, Leadenhall Street, E.C.	Dicker, London ...	Avenue, 4308 ...	1, 2
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D 10	**DAVY, W. J.**	3 & 5, Crown Court, Old Broad Street, E.C.	Management	152, Avenue ...	.....
D 11	**DELTA METAL CO., Ltd.**	110, Cannon Street, E.C.	Delta, London	Avenue, 11,292 ...	2
D 14	**DAVIS, JOHN & SON**	All Saints Works, Derby	Davis, Derby	240	1, 2
D 15	**DAVIS & PRIMROSE**	Gt. Junction St., Edinburgh	Etna, Leith	.....	1, 2
D 16	**DRYSDALE & CO.**	Bon Accord Engine Works, London Road, Glasgow...	Bon Accord, Glasgow ...	2505	.....
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E 3	EASTON, ANDERSON & GOOLDEN, Ltd. ...	Erith Ironworks, Erith, Kent ...	Easton's, Erith ...	Dartford, 4 ...	.....

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FOR CONTINUATION OF DIRECTORY SEE PAGE XI.

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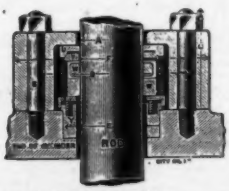

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— Фабричная марка —

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АНГЛІЯ

FEILDEN'S MAGAZINE : Directory *(continued).*
The numbers against the names refer to the corresponding numbers against the Specialities on pages iii, v, vii.

FEILDEN'S MAGAZINE : Annuaire de l'Acheteur.
Les numéros en regard des noms se rapportent aux numéros correspondants en regard des Spécialités aux pages iii, v, vii.

FEILDEN'S MAGAZINE : Des Käufers Rathgeber.
Die Nummern neben den Namen beziehen sich auf die betreffenden Nummern neben den Specialitäten auf Seiten iii, v, vii.

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F 7	**FLEMING, BIRKBY & GOODALL, Ltd.**	West Grove Mill, Halifax	Fleming, Halifax ...	48	.....
F 8	FLETCHER, JOHN & SON	Eagle Foundry, Salford, Manchester ...	Wheels, Manchester ...	2084	.....
F 9	**FIRTH, WM., Ltd.**	Leeds	.....	.....	.....
F 10	FOWLER, JOHN & Co. (Leeds), Ltd.	Steam Plough Works, Leeds... ...	Fowler, Leeds	513	.....
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G 10	GREEN, THOMAS & SON, Ltd.	Smithfield Ironworks, Leeds ...	Smithfield, Leeds ...	158	.....
G 11	GREENWOOD & BATLEY Ltd.	Albion Works, Leeds	Greenwood, Leeds ...	273	.....
G 15	**GLOVER, W. T. & CO., Ltd.**	Salford, Manchester	Phonoscope, London ...	.....	.....
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8. Unicode.
9. Bedford McNeill's.
10. Agers.
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FOR CONTINUATION OF DIRECTORY SEE PAGE XIV.

The Utilisation of Towns Refuse

for some practical purpose has been successfully solved, and there is, therefore, no reason why every township should not have its own Electric Installation, and obtain the power from its dust bins.

At DARWEN, LANCS, the whole of the power for ELECTRIC LIGHT INSTALLATION is obtained from TOWNS REFUSE, no coal-fixed Boilers being provided. At ST. HELEN'S the ELECTRIC TRAMS are worked from REFUSE DESTRUCTORS.

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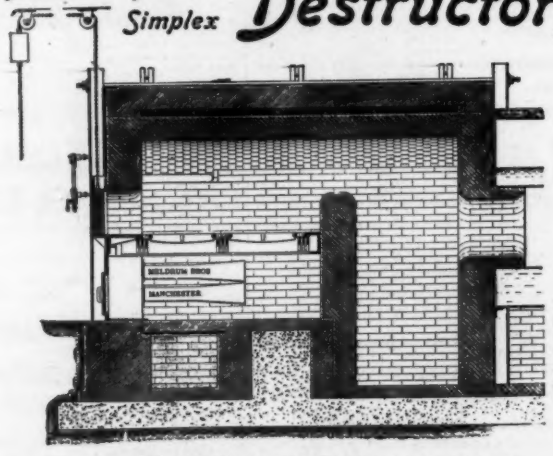

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Foyer "Meldrum."

Afin de pouvoir livrer à bon marché les produits manufacturés, il est indispensable d'en réduire le prix de revient. Quiconque utilise la force motrice, s'il lui arrive parfois de se rendre compte de ce que lui coûte le combustible nécessaire à la production de la vapeur, doit certainement se demander s'il n'existe pas quelque moyen permettant de diminuer la dépense encourue de ce chef. Or, ce moyen existe. Il suffirait, en effet, d'avoir à sa disposition un appareil remplissant certaines conditions essentielles pour pouvoir réaliser, sur ces frais, une économie de 10 à 30 %. C'est là un fait reconnu.

Si l'on vous offrait du fer, de l'acier, du coton, de la laine ou toute autre matière première dont vous pourriez vous servir pour votre genre de fabrication, à un prix réduit, ne fût-ce que dans des proportions très-minimes, il va sans dire que vous examineriez une offre semblable très sérieusement. Pourquoi, dès lors, n'étudieriez vous pas avec le même soin la question du combustible, qui touche vos intérêts de si près?

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Ces foyers conviennent à tous les types de Chaudières utilisent toute espèce de combustible en résistance à tous les climats.

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VOIR L'ILLUSTRATION A LA PAGE CI CONTRE 7.

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ECONOMIA EN LA GENERACIÓN DE VAPOR.

El Hogar "Meldrum."

PÍDANSE CATÁLOGOS.

Cuando rigen precios bajos en los artículos manufacturados precisa reducir el costo de su producción. Los que emplean el vapor como fuerza matriz siempre que consideran el costo del carbon consumido ven la necesidad de hallar el medio de disminuirlo y quizás no se les ocurra el hecho indiscutible de que ello se puede lograr empleando aparato adecuado, como lo es el Hogar Meldrum que produce una economia de **10 á 30 por ciento.** Todo industrial al comprar los materiales que emplea, sean hierro, acero, lana, algodon ú otro cualquiera, estudiaria y de aprovecharia de la mas ínfima ventaja que viese en los precios; pues bien, por que no ha de merecer el mismo detenido estudio la economia en el consumo de carbon, que tanto contribuye á aumentar las utilidades? Los que deseen este ideal escriban á Meldrum Bros., Ingenieros, de Manchester, pidiéndoles detalles, quienes con gusto los suministrarán. Se cuentan por miles los Hogares Meldrum hoy empleados con éscito en Manchester, Bradford, Bolton, Oldham, Leeds, Halifax, Glasgow, Francia, Espana, Rusia, India, China, etc., etc., etc.

Hay 6000 en uso. Mas Vapor. Menos Costo.

Conveniente para todos los tipos de Calderas, toda clase de combustibile, todos los climas.

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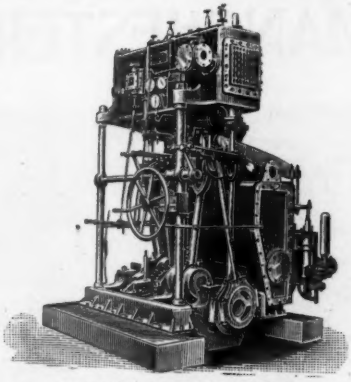

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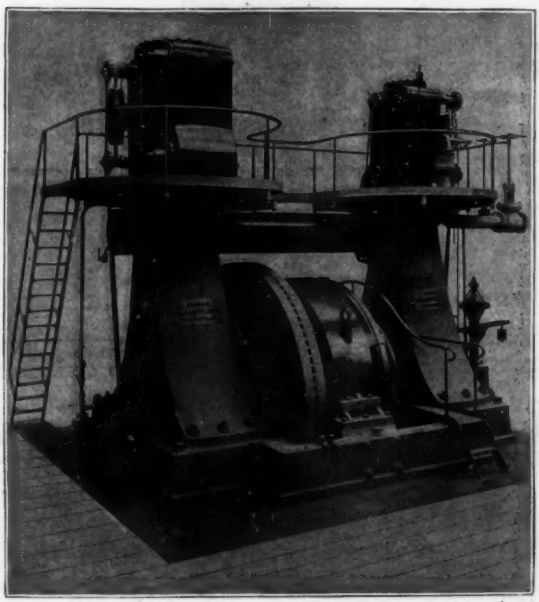

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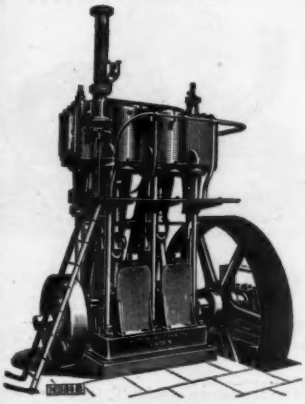

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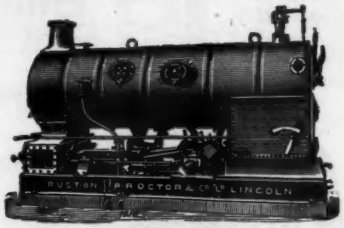

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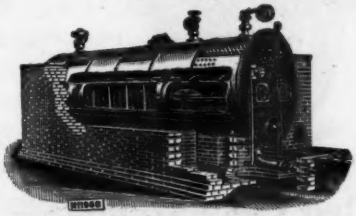

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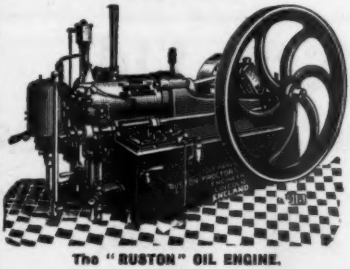

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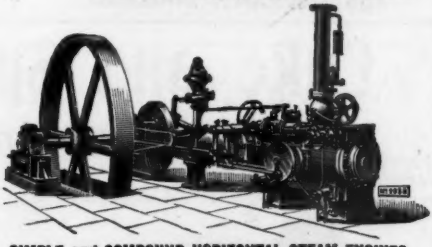

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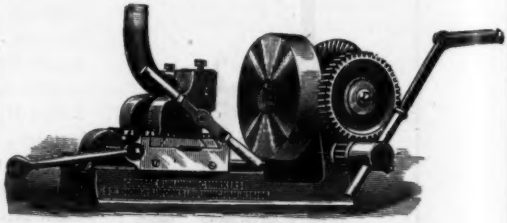

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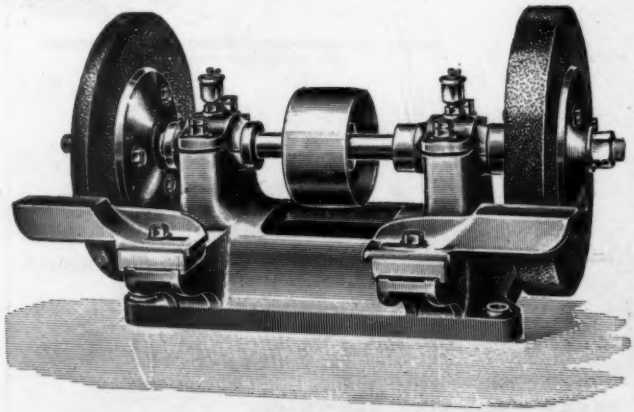

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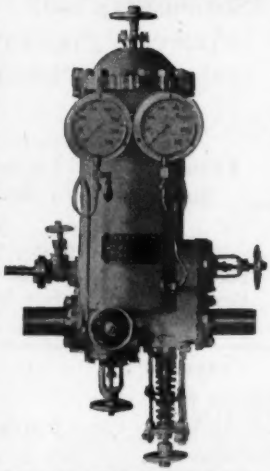

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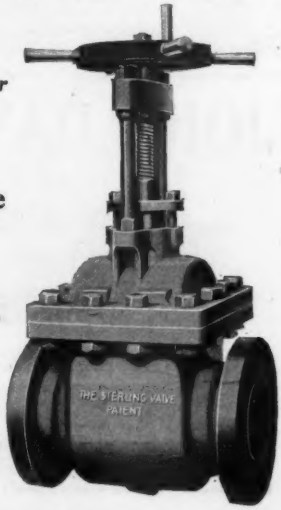

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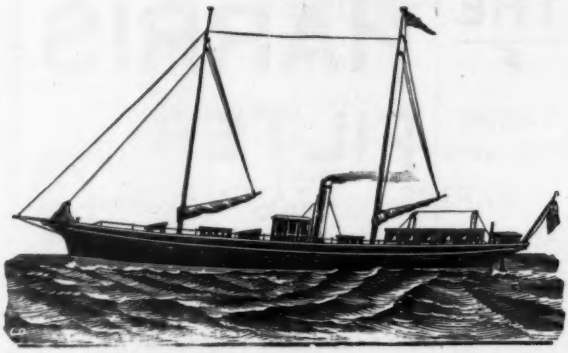

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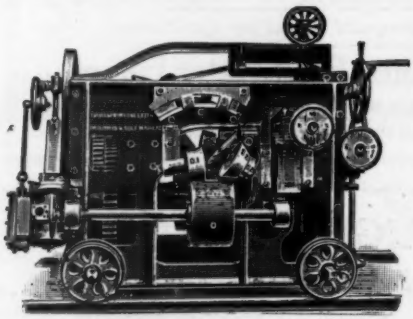

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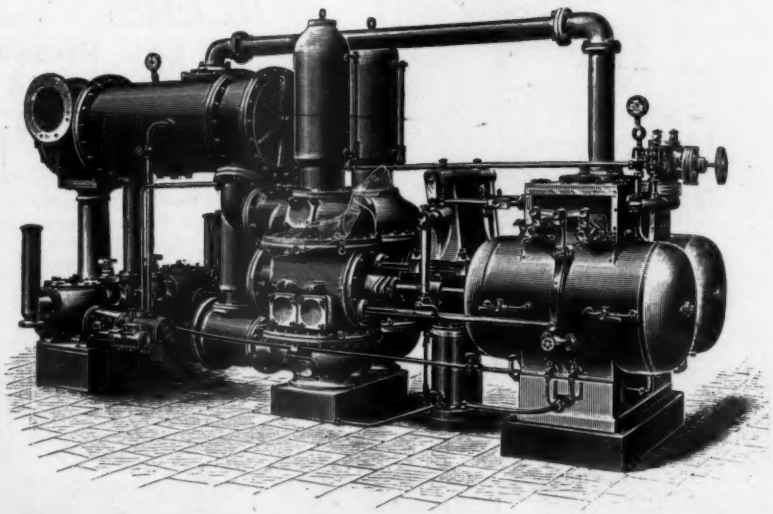

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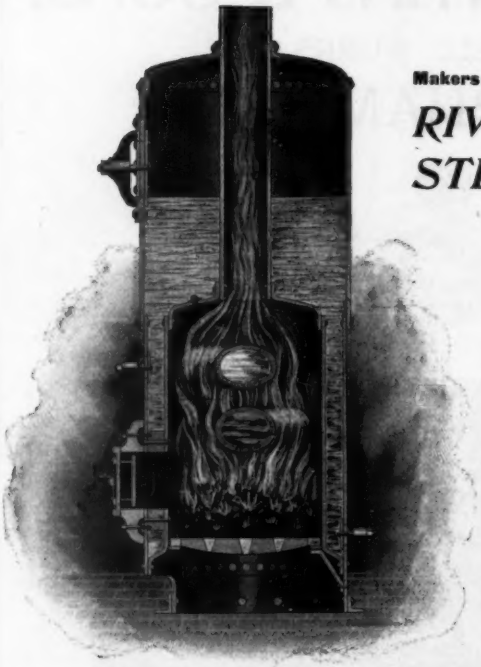

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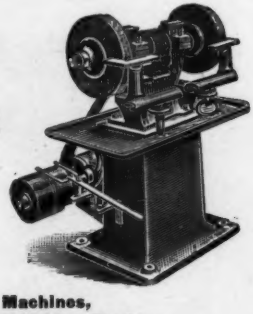

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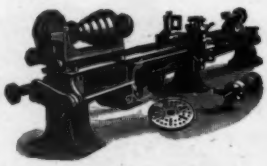

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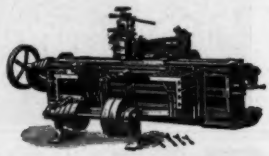

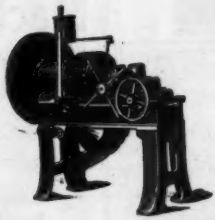

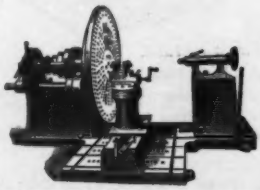

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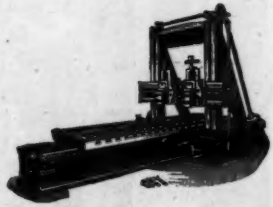

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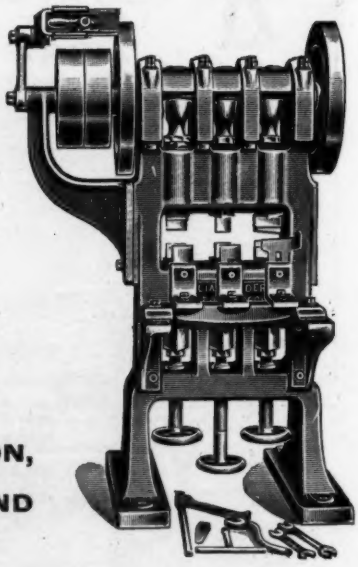

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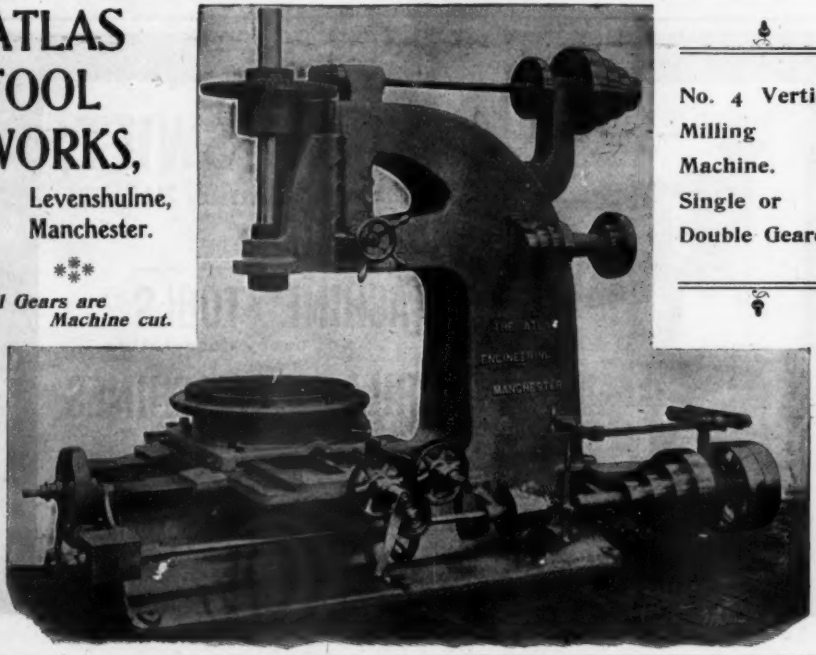

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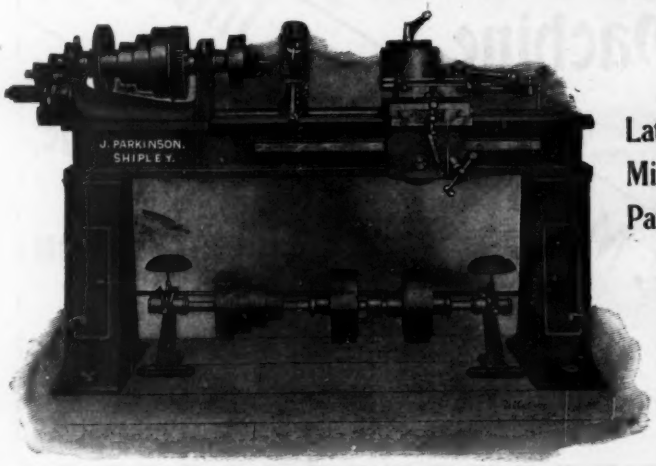

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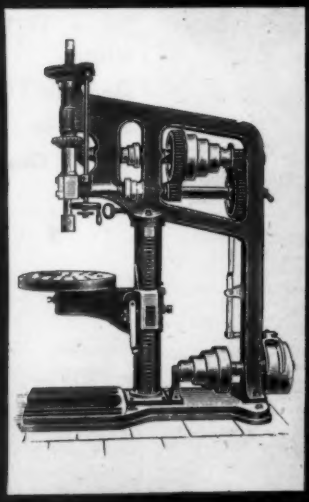

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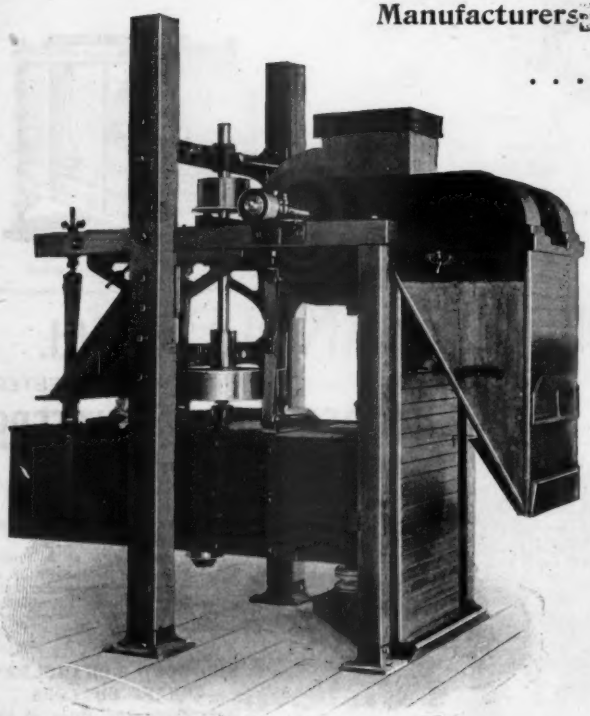

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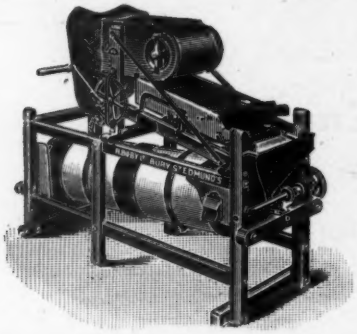

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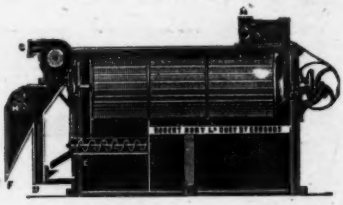

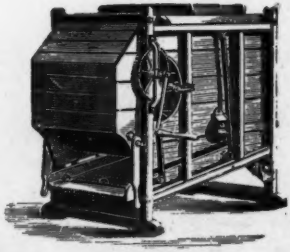

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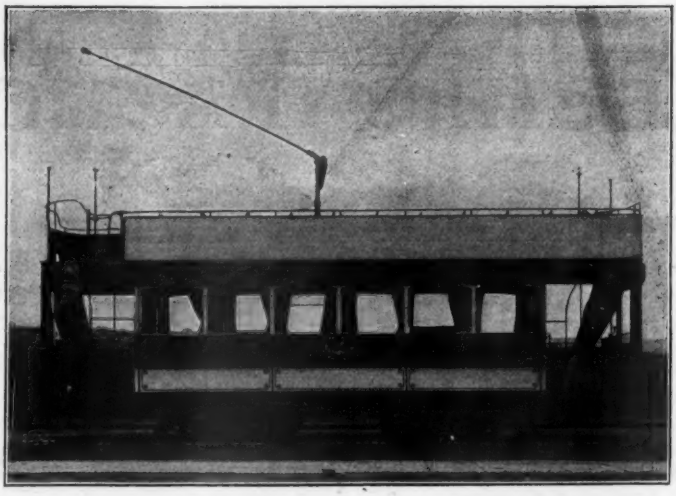

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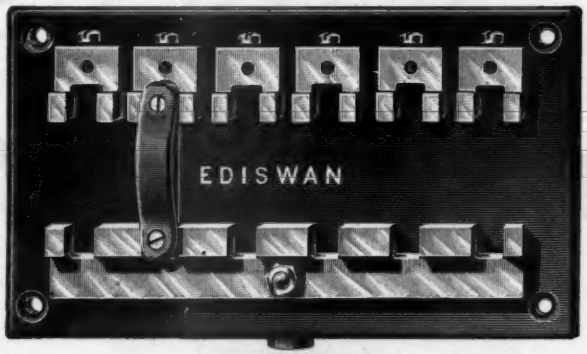

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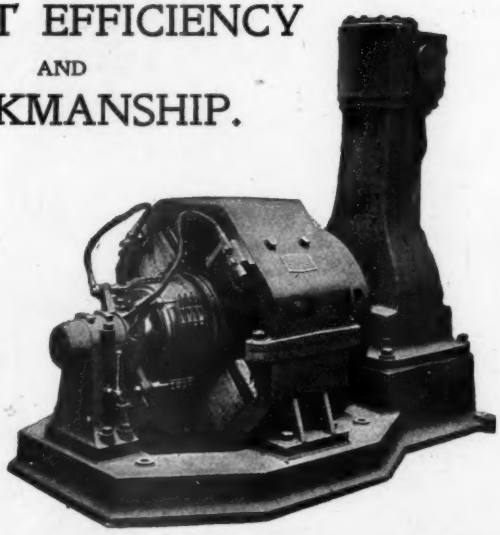

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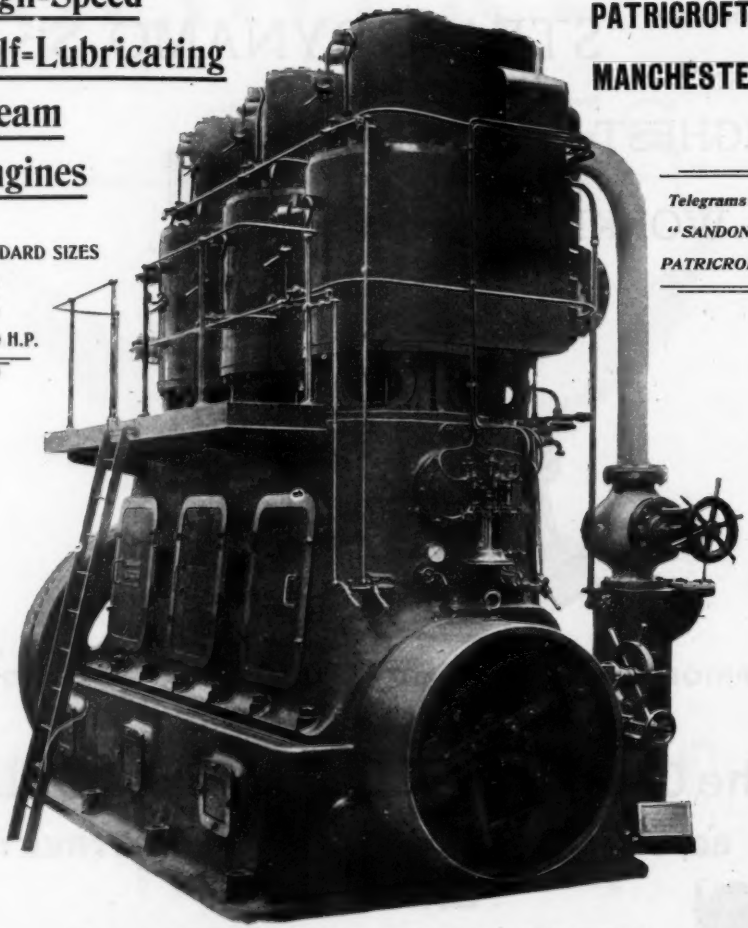

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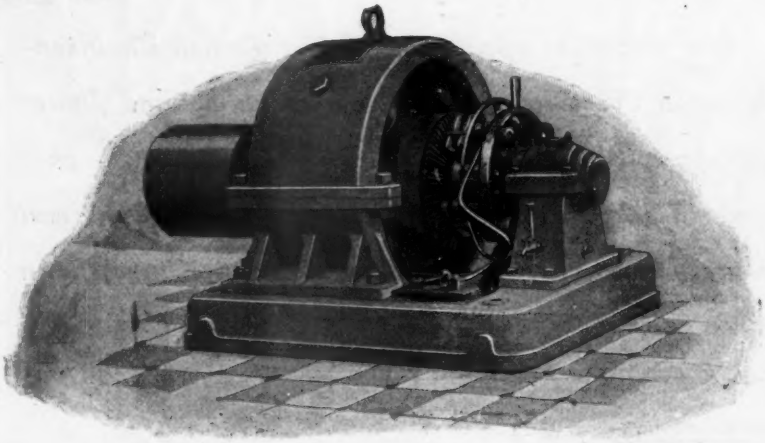

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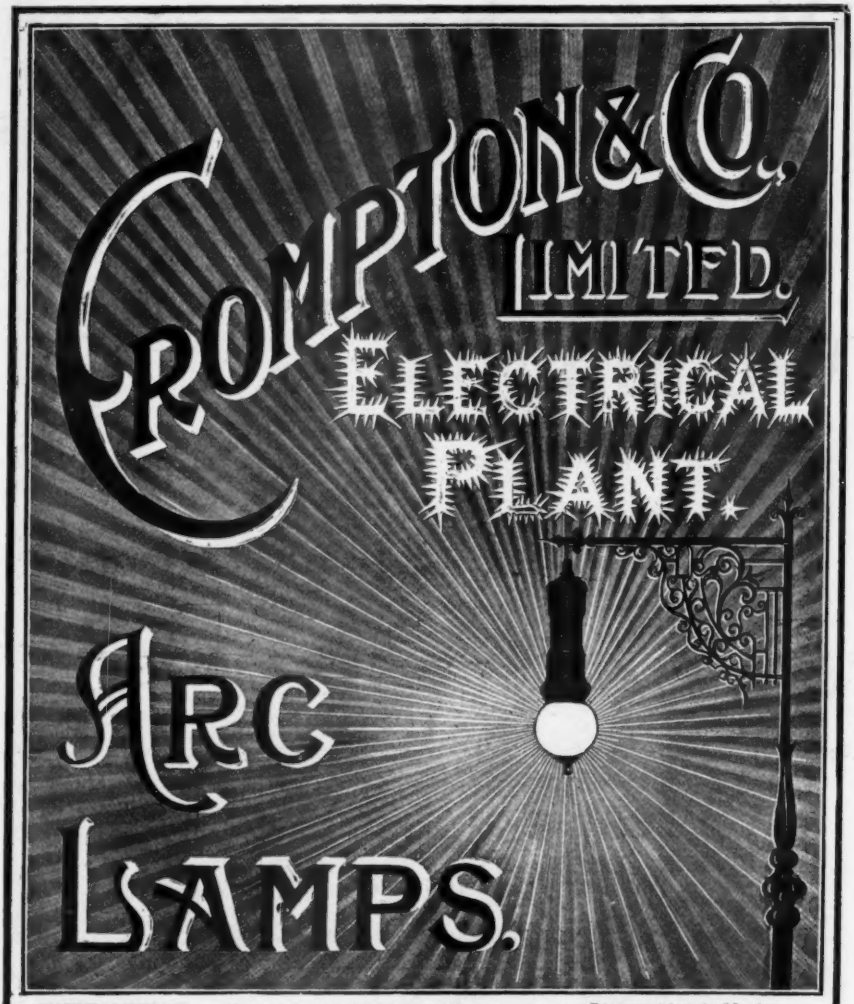

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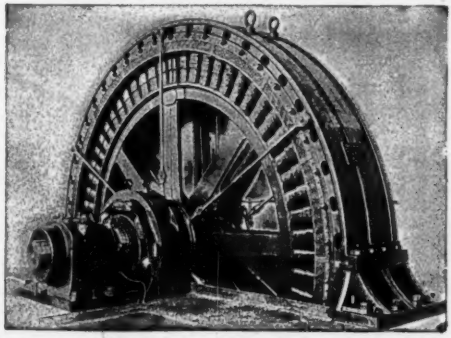

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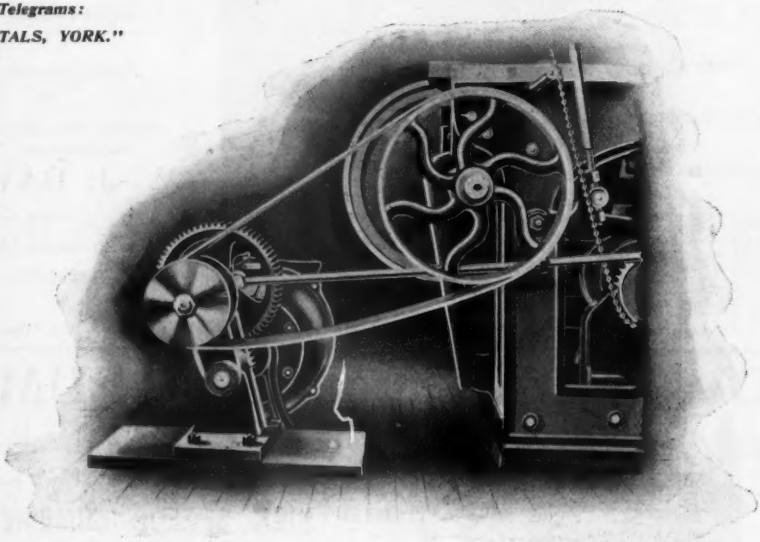

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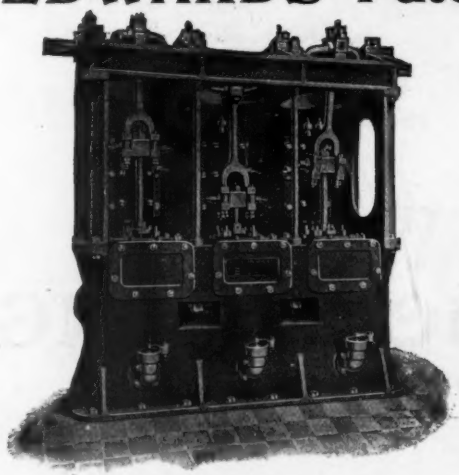

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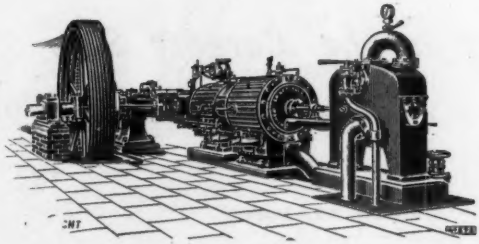

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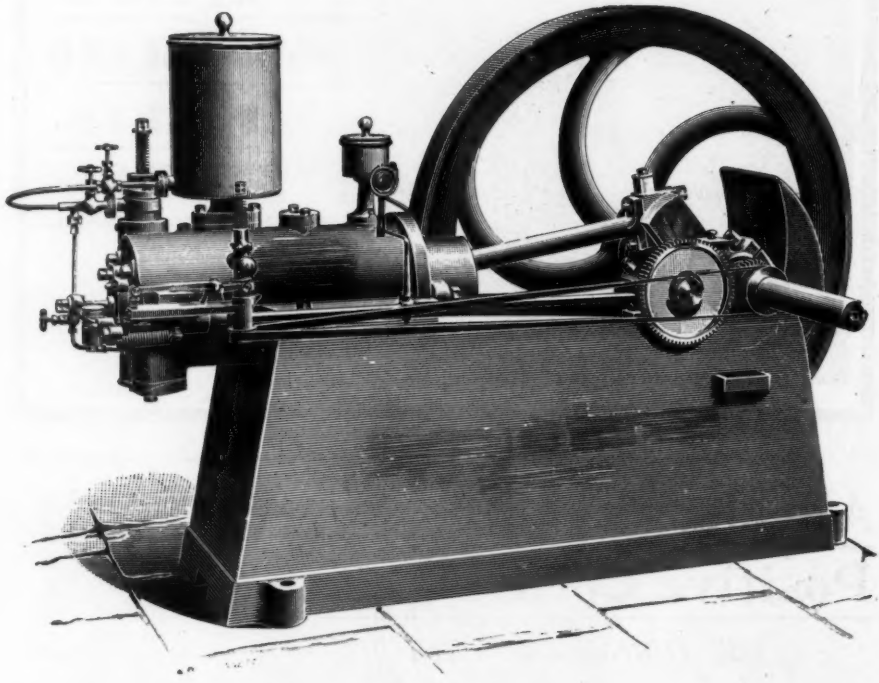

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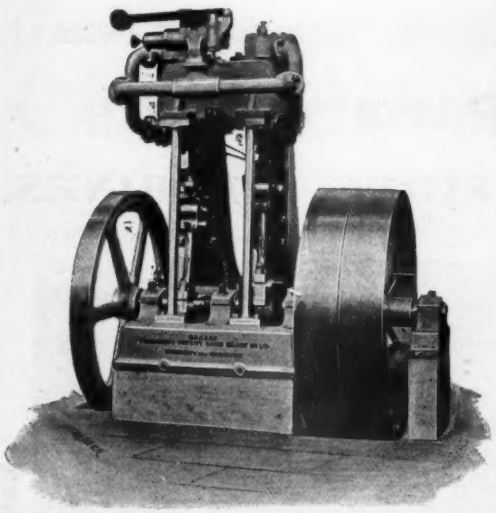

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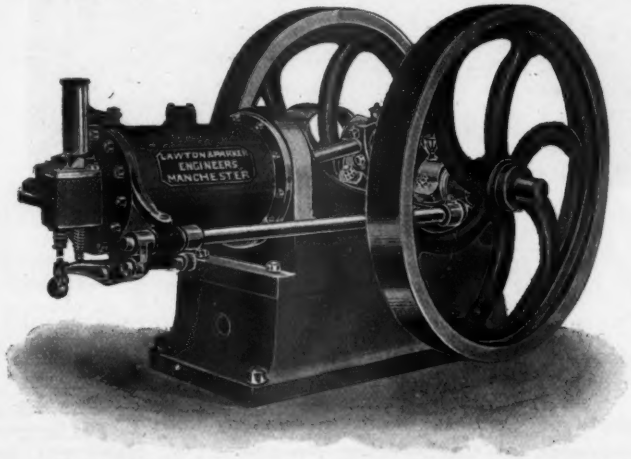

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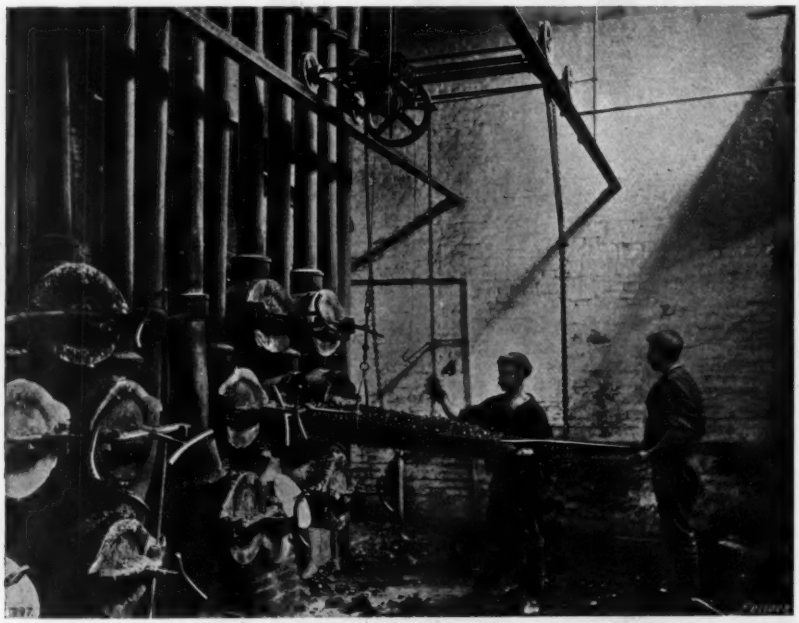

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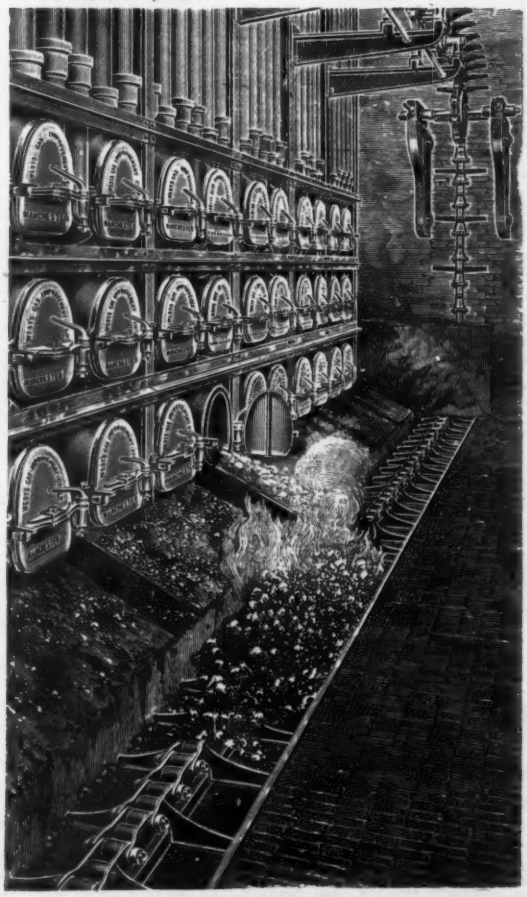

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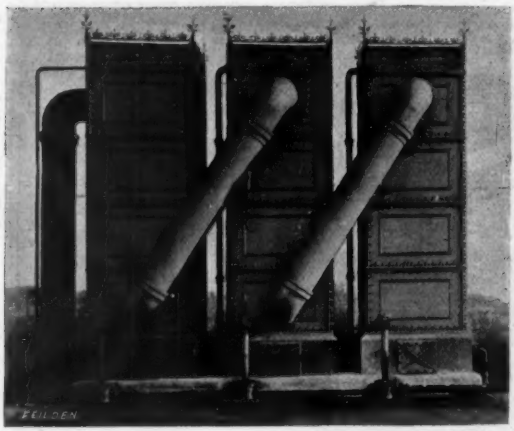

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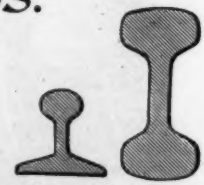

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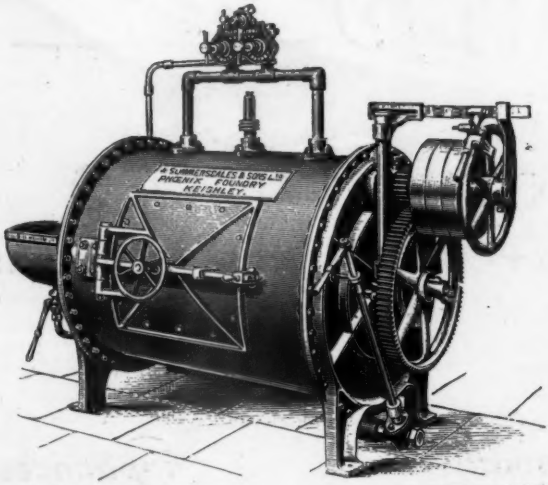

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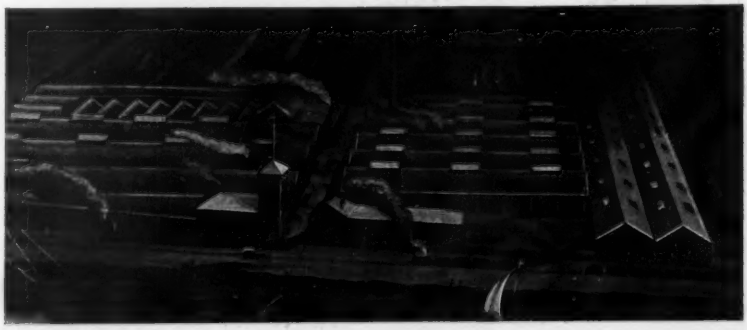

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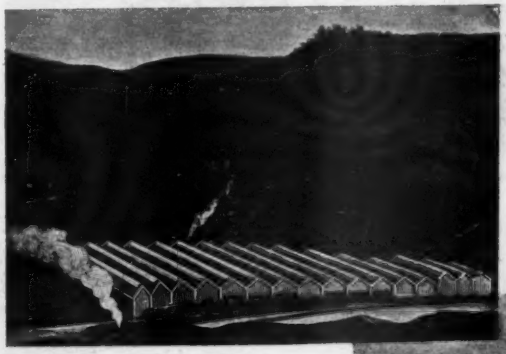

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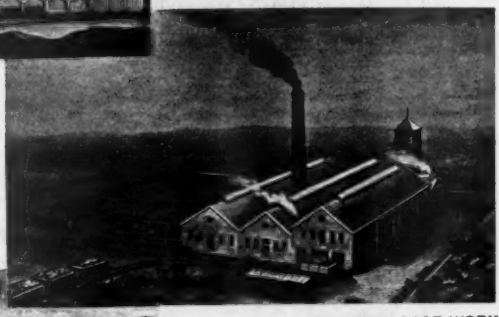

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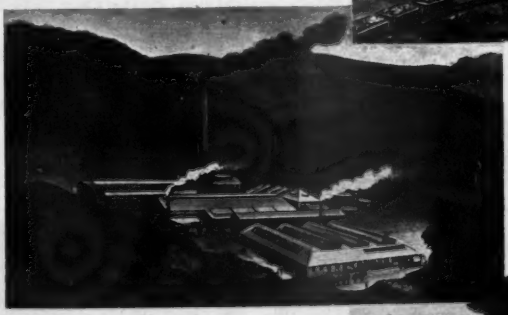

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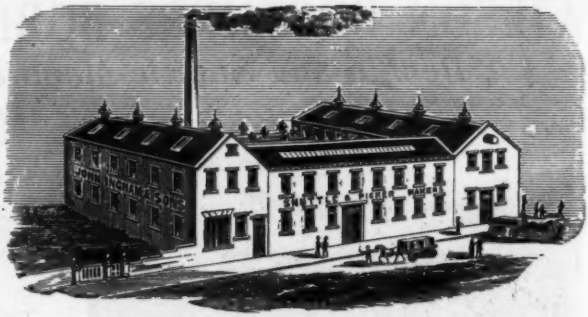

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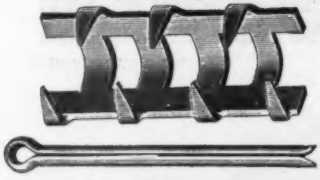

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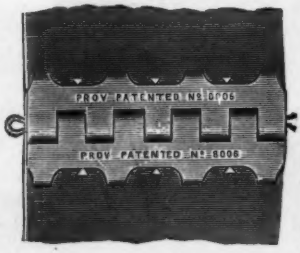

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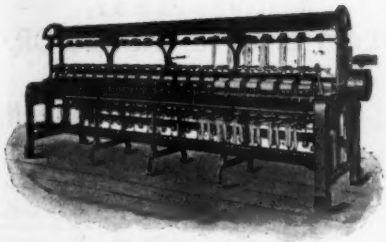

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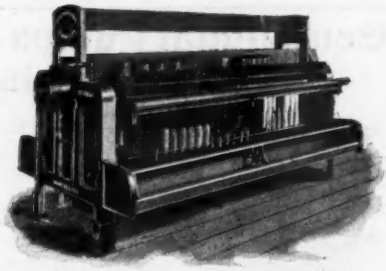

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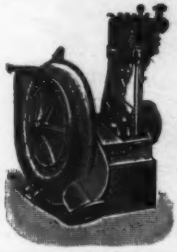

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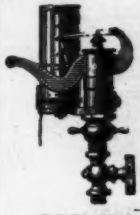

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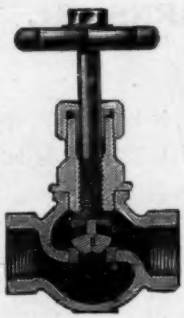

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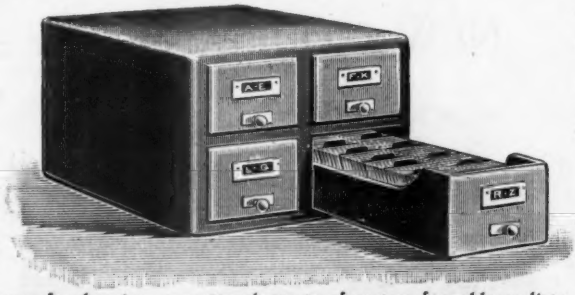

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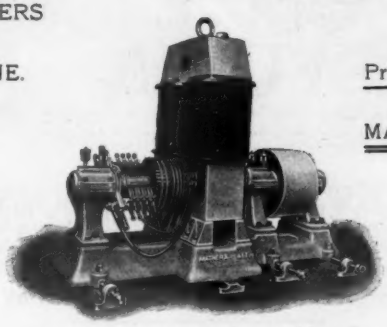

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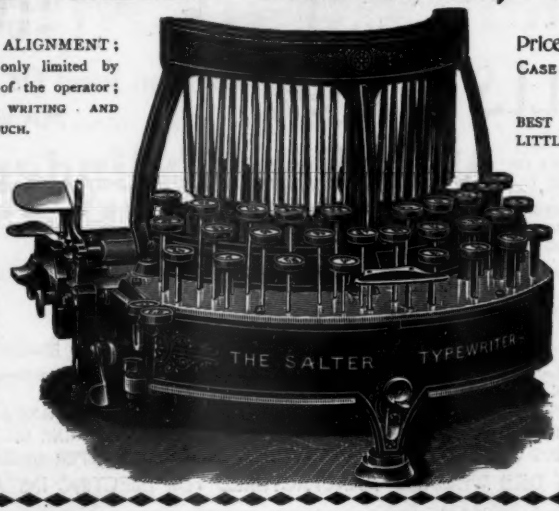

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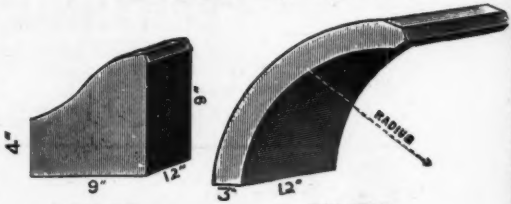

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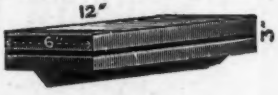

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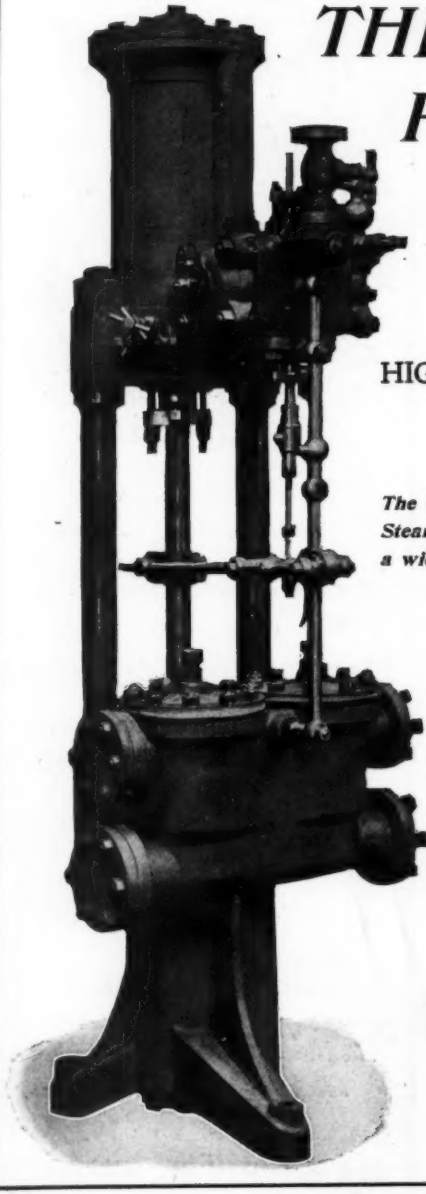

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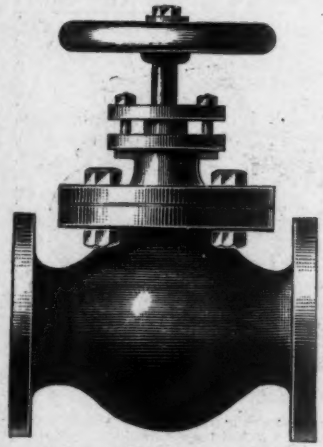

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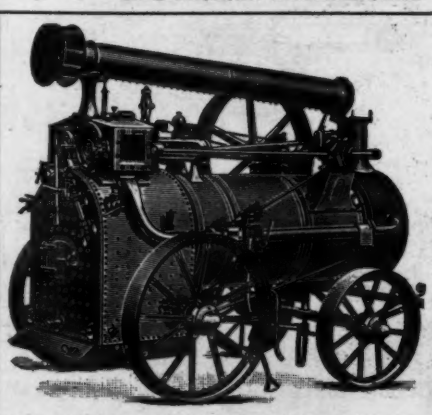

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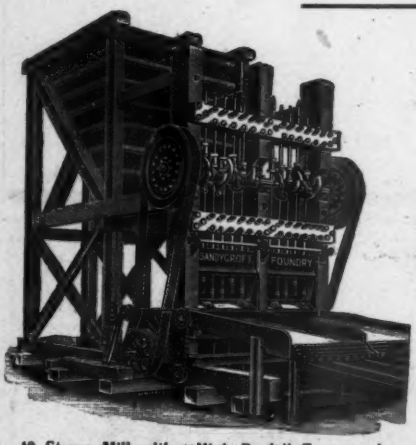

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